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# PROBLEM DEFINITION: PRESENT STATE OF WATER QUALITY IN THE DON RIVER – SUPPORTING DOCUMENT #4: STRATEGY FOR IMPROVEMENT OF DON RIVER WATER QUALITY

AUGUST 1991

Ontario
Environment
Environnement

ISBN 0-7729-7906-5

# PROBLEM DEFINITION: PRESENT STATE OF WATER QUALITY IN THE DON RIVER - SUPPORTING DOCUMENT # 4: STRATEGY FOR IMPROVEMENT OF DON RIVER WATER QUALITY

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Report prepared for:
Steering Committee
Toronto Area Watershed Management Study

AUGUST 1991

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PIBS 1624
log 91-2309-061

# EXECUTIVE SUMMARY

## 1. Study Scope and Purpose

The Ontario Ministry of the Environment (MOE) initiated a study of water quality in the Don River, Humber River and Mimico Creek in 1981 to provide baseline data to guide future studies. Subsequently, the Toronto Area Watershed Management Strategy Study (TAWMS) was formally organized. The objectives of TAWMS as outlined in the 1986 Report in the Humber Water Quality Management Plan are:

- To better define water quality conditions within the study area;
- To analyse the cause and effect relationships for problem constituents and areas; and
- To develop cost-effective measures for controlling pollutant loadings to the study area's receiving waters based on watershed needs and uses.

Initial emphasis was placed on studies of the Humber River watershed during 1982 through 1985. Mimico Creek was studied in 1982 and 1983 and the Don River is being studied from 1984 to 1987. The Humber River plan studies are essentially complete with a Water Quality Management Plan prepared and completed.

### Study Objectives

This present study is designed to develop a water quality management plan for the Don River. The objectives of the Water Quality Management Plan, as outlined in the Terms of Reference are:

i) Identify the water quality problems within the Don River.
ii) Relate these problems to sources.
iii) Suggest reasonable mitigative options and associated cost estimates.
iv) Develop a Water Quality Management Plan (WQMP).

### Study Scope

The plan shall include, but not be limited to alternative combinations of remedial and mitigating measures and strategies which achieve improvement in water quality of the

Don River. In developing such a plan, this study will critique the required environmental engineering sciences, evaluate the various possible measures, and relate them to such criteria as:

- their effectiveness and the associated protection attained;
- their costs;
- their ease of implementation;
- their acceptance by the public;
- their rating by municipalities;
- their conflict potential; and
- their impact upon other environmental factors not considered directly.

The main emphasis of this present study is to quantify the effectiveness of the different measures and the associated level of protection attained for water quality in the riverine ecosystem. The effectiveness of the different measures will then be qualitatively compared to the other criteria described above.

To evaluate the effectiveness of the different control measures, present day flows and concentrations of different contaminants from different sources must be estimated. The instream concentrations resulting from these loads are then calculated and compared to measured concentrations. Next, the effect of different control measures on the magnitude of source flow or source concentration and the associated costs are estimated. Then the impact of source control upon riverine concentrations can be calculated and the costs related to specific levels of protection of water quality.

Documentation on the Don River available to this study includes:

i) analysis of existing water quality, trends, and frequency of Provincial Water Quality Objective (PWQO) violations;
ii) a feasibility/scoping study of major problem areas;
iii) various technical documents detailing loadings from various sources and data compilation; and
iv) pollution control plans for two municipalities in Metropolitan Toronto (East York, Scarborough).

Where data are not available, literature values will be used to estimate source concentrations. Relevant sources include TAWMS - Humber, NURP (National Urban Runoff Program of the US EPA), and European studies for stormwater runoff, MISA sampling for wastewater treatment plants, and Enhanced Monitoring Program Data for rural areas.

This study approach will be different from that of the Humber. In the Humber, in-depth modelling studies of riverine response to different control options and in-depth studies of the costs and effectiveness of control options were made before development of the plan. In this study, a simple mass balance approach (loadings divided by dilution effects of the river) will be used in Phase II to assess riverine response. Because this is a different approach, the approach itself is innovative and the results must be viewed with caution. It is anticipated that after completion of this broad-brush approach, additional in-depth modelling studies of riverine response may be needed in the future to improve the calculations given in this report.

### Study Organization

This study was divided into two phases. The first phase defined the water quality problems and develop the WQMP objectives. Phase II evaluated the effectiveness of various control options, developed alternative pollution control strategies and identified the implementation strategies for the WQMP.

In this supporting document, source of contamination (Section 2) are characterized, the "problem is identified (Section 3), and the "objectives of the plan" are identified (Section 3).

## 2. Problem Identification

Problem identification includes definition of study reaches, fisheries objectives, selection of water quality parameters, assessment of sources of contaminants and evaluation of available loadings data.

## Reaches

The following reaches have been proposed.

| Area of Don | Reach |
|---|---|
| West | 1. West Don Above Langstaff Road |
| | 2. West Don to Confluence with Wilkett Creek |
| | 3. Wilkett Creek |
| | 4. West Don from Wilkett Creek to Main Don Confluence |
| East Don | 5. East Don Above Langstaff Road |
| | 6. Little Don Above German Mills Creek |
| | 7. German Mills Creek |
| | 8. Lower East Don, German Mills to Confluence |
| Lower Don | 9. Massey Creek |
| | 10. Lower Don From Confluence to STP |
| | 11. Lower Don From STP From Keating Channel |

## Fisheries Objectives

An assessment of the Don River fishery and its potential objectives were made in consultation with technical staff from the Ministry of Natural Resources, Ministry of the Environment, and Metropolitan Toronto Regional Conservation Authority. The deliberations are summarized in the document under the following headings.

1. Section Boundaries
2. Fisheries Objective for Section
3. Limiting Factors to Existing Fishery
4. Collected Species
5. Target Species
6. Current Water Quality Impacts Upon Fisheries
7. Management Requirements/Focus
8. Broad Management Criteria

9. Management Philosophy for River Section Within Overall Watershed Perspective
10. Tools Available for Quantifying Impacts
11. General Priorities for River Section.

The fishery objectives and management philosophy for the different sections are summarized in Table 0.1.

## Water Quality Parameters

A review of time trends, seasonal effects and PWQO violations of all water quality parameters is presented in the Supporting Document 5. Based upon this analysis, a set of parameters are given in Table 0.2 as marker variables for assessing the response of the Don River to water quality control.

Monitoring data are available from six stations in the Provincial Monitoring Network, from specialized stations established for TAWMS (e.g., for pesticides, dry weather flow estimates, etc.), and the Enhanced Monitoring Program. Its analysis indicate that the upper undeveloped reaches are impacted mainly by agricultural activities and construction associated with development of the urbanizing fringe. The middle reaches are further impacted while the downstream main stream below the confluence has the worst water quality. Special tributary streams (Wilkett Creek, Massey Creek) suffer from CSO and/or industrial discharges/spills effects.

The water quality data for the 1980's indicate that the river is often turbid, and eutrophic. It has high bacterial counts and high temperatures in the summer. The river has plentiful oxygen resources with few observations below 6 mg/L. This indicates that treatment and control of oxygen demanding substances has met previously set water quality objectives. The river is likely toxic in the lower reaches downstream of the North Toronto Wastewater Treatment Plant (WWTP) to Lakeshore Blvd. due to ammonia discharges. Toxicity due to metals or synthetic organic chemicals (SOC's) is plausible but uncertain due to sorption onto suspended solids and a paucity of data. In place pollutants may be problematic in the sediments of Keating Channel and may pose an impact on salmonoid fish during their migration. The fishery quality is poor, but this may be primarily due to habitat/hydrologic factors.

## TABLE 0.1: SUMMARY OF FISHERIES OBJECTIVES

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## TABLE 0.1a: DON RIVER ABOVE LANGSTAFF

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- Section Boundaries - head water reaches above Langstaff
- Fisheries Objective - status quo - fish species/habitat
- Limiting Factors
  - riparian vegetation removal
  - base flow - change small marginal stream to intermittant
  - barriers to movement of fish - physical and chemical
- Target Species
  - red side dace - spotty present distribution with higher habitat/water temperature requirements - quality habitat indicator
  - sculpin - cooler water requirements and instream cover
  - creek chub-target species
- Current Water Quality Impacts
  - no direct impacts discernable
  - turbidity from construction activities will be a major future impact
- Broad Management Criteria - For Headwater Streams
  1) maintain or improve fisheries potential in middle or lower reaches.
  2) create "artificial" fisheries potential in headwater areas - ponds.
- Management Philosophy of Upper Don Within a Watershed Perspective
  1) Fish species selected are an indication of good water quality and a balanced ecosystem.
  2) Fish species such as minnows are a food source for downstream fishery.
  3) The scope for management is limited because the riverine fishery of order 1 and order 2 streams are always limited to a small number of several species.

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## TABLE 0.1b: TRIBUTARIES: GERMAN MILLS, WILKETT CREEK, MASSEY CREEK

- Fisheries Objective
    1) improvement in streams (creek chub indicator)
    2) mitigate water quality impacts to main river

- Limiting Factors
    - chemical spills major problem
    - habitat loss - channelization extensive
    - barriers to fish migration
    - high peak flows (note: base flows appear adequate for sustaining a fishery)

- Target Species
    - target species creek chub

- Current Water Quality Impacts
    - water quality and flow conditions major issues. This limits fish fauna even where suitable habitat remains. Some excellent habitat sections remain in park areas.
    - the major effect on lack of fish may be spills of toxic substances such as ammonia.
    - the possibility of ammonia avoidance needs further analysis since the unionized ammonia levels in monitoring data are below PWQO's.

- Management Requirements/Focus
    - spill control by ponds.
    - water quality improvement - industrial sources.
    - responses to above limiting factors.

- Broad Management Criteria for Tributary Streams
    - maintain or improve fisheries potential in middle and lower reaches.
    - re-establish missing species.

## TABLE 0.1c: MIDDLE REACHES OF DON RIVER

- Section Boundaries
  - Langstaff Road to Bloor Street (west and east Don branches)

- Fisheries Objective
  1) Status quo minimum - creek chub
  2) largemouth bass capability - ecosystem criteria

- Limiting Factors
  - excessive peak flows - effects on river channel and habitats - eroded channels.
  - areas of good riparian vegetation and canopy - extensive park systems.
  - poor instreams habitat - shallow flows, wide channel, no instream cover, poor stream morphologic development (riffles/pools).
  - water quality problems - excessive silt loads, some toxic inputs (spills).
  - some channelization.
  - weir at Pottery Road a migration obstacle for lake migrant populations.

- Target Species
  - creek chub - status quo.
  - largemouth bass
    - potential capability
    - represent ecosystem restoration
    - predator for "big four" resident species.
    - indicator of acceptable water quality/balanced fish community/food chains.

- Current Water Quality Impacts on Fishery
  - turbidity and silt loads.
  - chemical spills.

- Broad Management Criteria for Middle Sections
  1) maintain status quo
  2) make habitat and water quality improvements to:
     - improve fishery
     - act as an integrator of a more balanced ecosystem.

- Management Philosophy of Middle Reaches Within a Watershed Perspective
  1) It would be difficult to substantially alter the design of the urban areas and their impacts upon flow and turbidity (bank erosion).
  2) There are opportunities for achieving significant impacts by:
     - improving riparian habitat.
     - controlling water quality excesses associated with spills and other types of extremes.

## TABLE 0.1d: LOWER REACHES OF DON RIVER

- Section Boundaries
  - Bloor Street to Keating Channel

- Fisheries Objective
  1) As in middle reaches.
  2) Suitability for seasonal use by anadromous salmonids from Lake Ontario (brown trout, chinook salmon)

- Limiting Factors
  - water quality - stormwater (CSO) discharges to lower river, STP input, industrial spills.
  - channeled lower section and estuary (harbour).
  - major siltation of river habitats.
  - riparian vegetation minor factor.
  - channel morphology major limitation - substrates, lack of riffles/pools, shallow depths (wide scoured channel).
  - no migration obstacles (physical).

- Target Species
  - creek chub - status quo indicator.
  - largemouth bass - ecosystem restoration (as for middle reaches).
  - brown trout - representative for anadromous salmonids.
    - more tolerant species for temperature and turbidity.
    - for anadromous run only - not self-sustaining.
    - indicator for chinook salmon, coho, etc.

- Current Water Quality Impact on Fishery
  - turbidity some impact.
  - temperature limits fishery to warm water species.
  - perceived impact of CSO's, STP's, industrial discharge and spills; exact impact is not well quantified.

- Management Objective/Focus
  - achieve water quality conditions suitable for fish movement through river below Bloor - no habitat sector/functions justified below Bloor.

- Broad Management Criteria for Lower Reaches
  1) Maintain status quo.
  2) Make modest improvements by:
     - improvement of habitat where practical.
     - improve water quality.

Table 0.2: Proposed Parameters and Rationale for Selection

1. Major Parameters

| Parameter | Reach | Rationale for Selection |
|---|---|---|
| Flow | Main branches | o carrier solvent (fluid) |
| Suspended Solids | Main branch | o critical parameter for aesthetics and fisheries (turbidity)<br>o carrier material for many contaminants |
| Total Phosphorus | Main branches | o control eutrophication in many aquatic systems |
| Fecal Coliforms | Main branches | o Indicator organisms for swimming objectives |
| Colour | All branches | o indicator of aesthetics |
| Dissolved Oxygen | Selected Branches* | o Critical parameter for fish |
| BOD | Selected Branches* | o Parameter influencing DO |
| TKN | Selected Branches* | o Parameter influencing DO |
| Ammonia | Tributaries | o Parameter potentially toxic to fish |
| Chloride | Main Branches | o Conservative parameters as traces of waters |

*Selected branches: 1 tributary, one main stem section are suggested.

2. Metals

| Parameter | Reach | Rationale for Selection |
|---|---|---|
| Copper | Main branches | o PWQO exceedance |
| Zinc | Main branches | o PWQO exceedance |
| Lead | Main branches | o PWQO exceedance |

3. Herbicides, Pesticides, and Industrial Organics

The following compounds are proposed. Because many of the demonstrated problems are reach-specific, few compounds will be evaluated on a watershed basis.

| Parameter | Reach | Rationale for Selection |
|---|---|---|
| Atrazine | Main branchs of East, West, Lower Don | o Herbicide used in agricultural (corn) systems.<br>o Has short decay times; is transported by soil leaching and erosion.<br>o Will be a sensitive variable for looking at impacts of development of upper watershed.<br>o Assume no contributions from urban areas. |

|  |  |  |
|---|---|---|
| Methoxychlor | Wilket Creek<br>Lower West Branch<br>Lower Don | o Exceedances observed in these branches<br>o Have few data on dry weather/event data.<br>o Search MISA data for WWTP data. |
| Lindane | Massey Creek<br>Lower West Branch | o Of particular interest to MOE.<br>o Sources can be explained.<br>o Have few data for STP or for dry weather/wet stormwater.<br>o Search MISA data for WWTP effluent characteristics and apply generically to North Toronto plant. |
| Reactive Phenolics | Lower West Branch<br>Lower Don | o Exceed PWQO's at Lakeshore site for entire period of 1964-1984. |
| PCP | ? | o Had significant number of exceedances.<br>o Not included in reactive phenolics test.<br>o Will completely follow suspended solids.<br>o Source data is leaching; may need to be dropped. |

4 Episodic Based Phenomena

|  |  |  |
|---|---|---|
| Spills<br>Construction | Main Stream<br>Upper Reaches | o Affect aesthetics and aquatic life.<br>o May exceed suspended solids from normal erosive activities.<br>o Assess using literature |

The long term trend analysis shows improvement of water quality in different reaches for certain parameters (e.g., BOD, ammonia) and occasional "dip" type decreases. These "dips" are generally associated with removal of certain STP discharges from the system (e.g., Richmond Hill in 1979) and gradual refinements in treatment. Trends are apparent over a twenty year period for two organic compounds (PCB's, reactive phenolics) but no trends are apparent for trace metals or other organic compounds because the monitoring data strings are too short.

Seasonal effects are also evident in the data set. They are caused by temperature variations (e.g., dissolved oxygen saturation) and flow effects and the effects of flow upon suspended solids. The suspended solids effects are observed for metals and trace organics which sorb to, or are associated with the solid phase. In many instances, the highest exceedances of PWQO's are observed during periods of high suspended solids concentration. Whether such concentrations represent toxic conditions need to be evaluated because many toxicity tests are conducted in the presence of only small quantities of particulate matter.

## Sources and Loading Estimates

A variety of sources have been identified (see Table 0.3). An assessment of available data for source concentrations and flows has been made. A summary of available data for the selected water quality parameters is given in Table 0.4. Where data are not available, literature estimates or assumptions are indicated.

To establish flows, available monitoring data will be used and related to Water Survey of Canada gauging data for dry weather and wet weather conditions. If the flow balance for these conditions does not close, a procedure given in the report will be used to evaluate closure.

The validity of the loading estimates will be made for existing conditions by comparison with monitoring data.

## 3. Plan Objectives

Stakeholders concern and the results of public consultants are reviewed in this report.

Table 0.3: Potential Sources of Pollutant Loadings To The Don River

| Source | Periods During Which Loadings May Occur | |
|---|---|---|
| | Dry | Wet |
| North Toronto STP Effluent | X | X |
| North Toronto STP Bypasses | | X |
| Storm Sewer Discharges | X | X |
| Seepage/Infiltration | X | |
| Cross Connections | X | X |
| Combined Sewer Overflow | | X |
| Spills | X | X |
| Snow Dumps | X | X |
| Industrial Discharges | X | X |
| Landfill Sites | X | X |
| Agricultural Sources | X | X |
| Stream Bank Erosion | | X |
| Construction Activities | | X |
| Atmospheric Fallout | X | X |

## TABLE 0.4a: POLLUTANT CONCENTRATIONS AND LOADINGS FOR THE NORTH TORONTO STP

| Parameter | Concentration | Loading* |
|---|---|---|
| Suspended Solids | 8.3 mg/L | 284,689 gm/day |
| Total Phosphorus | 0.8 m/l | 28,126 gm/day |
| Fecal Coliform | 3.4 org/100 ml | 1.35 x $10^5$ org/sec. |
| Zinc | 0.07 mg/L | 2,401 gm/day |
| Copper | 0.04 mg/L | 1,372 gm/day |
| Lead | .04 mg/L | |
| Chlorides | N/A | |
| DO | 7 mg/L*** | |
| $BOD_5$ | 14.7 mg/L | |
| TKN | 6 mg/L*** | |
| Ammonia | 5 mg/L** | |
| Atrazine | ** | |
| Methoxychlor | ** | |
| Lindane | ** | |
| Reactive Phenolics | ** | |
| PCP | ** | |

** MISA data will be obtained and applied generally

*** Values assumed

TABLE 0.4b: REPRESENTATIVE URBAN RUNOFF EVENT MEAN CONCENTRATIONS FOR VARIOUS WATER QUALITY PARAMETERS

| Parameter | Residential | Mixed | Commercial | Rural |
|---|---|---|---|---|
| Suspended Solids[1] | 101 | 67 | ? | 70 |
| Total Phosphorus[1] | 0.383 | 0.263 | 0.201 | 0.121 |
| Fecal Coliforms[2,3] | $5 \times 10^3$ | $5 \times 10^3$ | $5 \times 10^3$ | 300 |
| Zinc[1] | 0.135 | 0.154 | 0.226 | 0.195 |
| Copper[1] | 0.033 | 0.027 | 0.029 | 0.003 |
| Atrazine | LTD | LTD | LTD | 10 ng/L |
| Methoxychlor | ? | 900 ng/L | ? | ? |
| Lindane | ? | ? | ? | ? |
| Reactive Phenolics | ? | 23 ug/L | ? | ? |
| PCP | ? | ? | ? | ? |

NOTES

a) All units mg/L except fecal coliforms (org/100 ml)
b) 1 = NURP data
c) 2 = MOE, PCP guidelines
d) 3 = Monitoring data for Little Rouge River, at Steeles Avenue
e) LTD = less than detection
f) ? = no data obtained

Existing water quality in the Don River is related to the PWQO's in this report and the rationale for the numerical value of the PWQO reviewed. The comparison to PWQO's is summarized in Table 0.5.

## Levels of Protection

For each reach, potential levels of protection will be identified. These levels, in ascending order, include:

i) status quo;

ii) limited aesthetic and limited water quality improvement;

iii) substantial water quality and aesthetic improvement, urban sports fishery in target areas

iv) body contact recreation in many areas; warm water fishery throughout the Don River system

v) body contract recreation; warm water fishery; aethetically acceptable, achievement of the Provincial Water Quality Objectives (PWQO) most of the time.

One of the tasks of this study has been to better define the feasible levels of usage for each reach based on existing water quality data and a review of viable remedial alternatives. This assessment is given in the Summary Report and in Supporting Document 2.

In assessing the potential level of protection for water quality, several beneficial water uses and bases for environmental regulation and associated water quality parameters which may limit these uses, have been identified. These include:

o swimming - bacteria;
o canoeing - water clarity (turbidity, presence/absence of oil spills);
o human health - drinking water rationale (parameter to be selected);

Table 0.5: Comparison of Don River Water Quality to PWQO's

| Parameter | Comparison to PWQO |
|---|---|
| Suspended Solids | o difficult to compare due to form of statement.<br>o PWQO is probably meant for lakes rather than rivers. |
| Total phosphorus | o 30 ug/L objective is routinely surpassed (80%).<br>o for 100 ug/L EPA standard, East Don exceeds 30%, West Don 50-60% and Lower Don 90% of time. |
| Fecal Coliforms | o Lower Don and East Don - greater than 90% except for Todmorden which is 75%.<br>o West Don - 70-80% exceedances. |
| Colour | o No data available. |
| Dissolved Oxygen | o Greater than 5 mg/L most of the time at all stations. |
| BOD | o No standards; relationship to DO is crucial. |
| TKN | o Ditto BOD |
| Ammonia | o For its impact upon DO, no standard. |
| Unionized Ammonia | o 37% of time at Lakeshore Blvd., and 17% of time at Todmorden. No violations in East or West Don.<br>o Fish avoidance in tributaries, suspected to be caused by high ammonia concentrations, is not documented in monitoring data. |
| Copper | o 80% exceedance over the whole seasonal cycle in Lower Don; 30 to 60% in East Don; 60 to 70% in the West Don. |
| Lead | o 50% of samples in Lower Don, 40% of samples in West Don and 30% of samples in East Don exceed PWQO. |
| Zinc | o 30% of samples in Lower Don, 20-40% of samples in East Don, and 20-30% of samples in West Don exceed PWQO. |
| Atrazine | o No PWQO value. |

Table 0.5: Comparison of Don River Water Quality to PWQO's

| Parameter | Comparison to PWQO |
|---|---|
| Methoxychlor | o No violations in routine sampling.<br>o 23% exceedance in spring snowmelt. |
| Lindane | o In routine monitoring, main branch - 32% exceedance, and west branch - 4% exceedance.<br>o In snowmelt, 23% exceedance. |
| Reactive Phenolics | o Main branch - 77% violation.<br>o West branch - 32% violation |
| PCP | o 9% violations, all occurring before 1984. |

- aesthetics
  - water clarity
  - presence/absence of odours and oil slicks/scum
  - frequency of spills
- fish
  - suspended solids
  - spills
  - ammonia
  - temperature

A considerable emphasis was placed on estimating the impact of water quality control on the existing fish population within the river and determining whether the habitat can be maintained or improved to accommodate additional species of fish.

Furthermore, the water quality management, if it is to be viable, must consider both existing and future conditions. The potential impact of future development, is primarily located adjacent to the headwaters.

## Statement of Study Objectives

The following objectives were proposed for the study.

1. Ensure that there no further degradation and attempt to achieve limited aesthetic and water quality improvements wherever possible.

2. Develop a warm water fishery which will provide an indication of aesthetic improvements but which will itself not be a significant recreational resource (in terms of fishing for consumption). Development of a put and take fishery with no tainted fish (e.g., no significant smell or carcinomas) whose source of contamination is attributable to the river, would be a second level fisheries objective. A third level would be fish contaminant levels below consumption standards for all metals and SOC's.

3. Achieve some degree of body contact recreation for an appropriate time period after stormwater runoff. This recognizes that even if all combined sewer overflows (CSO's) and WWTP bacterial discharges were eliminated, normal urban stormwater contains high enough levels to contaminate the river and minimize swimming. It suggests that over the long term, enough time between events and bacterial die-off

may result in swimmable sections of the river. Such areas may include the G. Lord Ross Reservoir. If such levels cannot be achieved naturally, curtained off areas and disinfection may provide areas in compliance for swimming.

As well, it is desired to achieve sufficiently low bacterial levels so that incident contact with river water (wading, falling into the river) does not result in a significant risk to the person involved. This may entail both control measures and changes in the indicator organism to a more specific organism which better describes the risk.

4. Evaluate the causes of PWQO exceedance and estimate the potential increase in compliance of PWQO's for various water quality parameters for different control options.

5. Develop a set of control measures with two planning horizons in mind

   - short-term (control can be directly achieved),
   - long-term (control is achieved by substitution of chemicals in the watershed, or as redevelopment occurs such as over a 50 year planning horizon).

6. Develop the control measures into management strategies and rank them qualitatively according to their:

   - level of protection attained,
   - cost-effectiveness,
   - implementability,
   - conflict potential,
   - inter-agency logistics, and
   - public acceptability.

7. Develop a plan which is cognizant of, and allows for, its reformulation due to such factors as:
   - further development in the headwater,
   - urban redevelopment in older areas of the watershed,

- different methods of solid/liquid waste handling,
- long-term climatic change (from effect on ozone layer; $CO_2$ build-up due to fuel consumption), and
- isostatic rebound.

# FOREWARD

## Study Background

In 1981, the Ontario Ministry of the Environment (MOE) began a study of water quality in the Don River, Humber River and Mimico Creek to provide baseline data to guide future studies. The following year, the Toronto Area Watershed Management Strategy Study (TAWMS) was initiated as a comprehensive and co-operative multi-agency undertaking towards the attainment of water quality improvements.

The TAWMS study objectives are:

- o To better define water quality conditions with the study area;
- o To analyse the cause and effect relationships for problem constituents and areas; and
- o To develop cost-effective measures for controlling pollutant loadings to the study area's receiving waters based on watershed needs and users.

Although wholly funded by MOE, TAWMS receives extensive co-operation and support from the Metropolitan Toronto and Region Conservation Authority (MTRCA), Metropolitan Toronto and area municipalities.

The TAWMS study is managed by a Steering Committee which includes representatives of the following:

Ontario Ministry of the Environment
Ontario Ministry of Natural Resources
Metropolitan Toronto & Region Conservation Authority
Environment Canada
Metropolitan Toronto
Borough of East York
City of Etobicoke
City of North York
City of Scarborough
City of Toronto
City of York
Regional Municipality of York
Regional Municipality of Peel
Town of Richmond Hill
Town of Vaughan
Town of Markham

A detailed study of the Humber River was carried out during the period 1982 to 1985. In 1986, the TAWMS Steering Committee released a Management Plan for the Humber River. Recommendations which were outlined in this plan are presently being implemented.

The TAWMS Don River Water Quality Improvement Study was commissioned as an external contract to Paul Theil Associates Limited and Beak Consultants Limited in the spring of 1988. The study's mandate was to summarize water quality problems, relate these problems to sources and to provide a range of improvement actions leading to various levels of control for water quality improvements. Options investigated for water quality improvement range from no further degradation to the full restoration of water quality in the Don River. The findings were presented as alternatives or staged management strategies which will lead to several milestones or levels of water quality improvement.

The improvement strategy incorporates findings from previous investigations of low flow and storm event conditions, snow melt, the status of biological communities and general water quality conditions within the Don River.

Public consultation on a number of strategies for water quality improvement for the Don River, combined with inputs from a range of municipalities and agencies will provide valuable direction for drafting the final Don River Management Plan. Improvement strategies outlined in this report for the Don River and other rivers which drain into the waterfront will be considered in context of the Metro Toronto Remedial Action Plan (RAP), a provincial-federal initiative for protecting water quality in Toronto's waterfront.

Implementation considerations and costs are important components in this option selection/consultant process, since they identify in simple terms what it will take to achieve a range of improvements and benefits or designated uses of the Don River. This consultation process will also recognize the will of municipalities, government agencies, developers and the public to support selected undertakings to protect and enhance water quality in the Don River.

The time span in which water quality improvements are to be derived and the ultimate costs will depend upon the levels of protection and the phasing of controls selected on the basis of public feedback and agency and municipality endorsement. It is recognized that effective improvement actions in the Don River watershed will also require creative solutions and new approaches by the municipalities and government agencies.

In addition to the remedial measures proposed in the strategy, a number of immediate actions are presently underway to address water quality problems by means of regular municipal and conservation authority works and maintenance programs, or through Ministry of the Environment programs such as the Waterfront Water Quality Improvement Program which funds physical work on the watercourses, waterfront or sewers yielding immediate benefits.

This document is Supporting Document 4 for the study. The complete set of study reports are as follows.

1. STRATEGY FOR IMPROVEMENT OF DON RIVER WATER QUALITY: SUMMARY REPORT
2. SUPPORTING DOCUMENT NO. 1: QUANTITATIVE METHODOLOGY FOR ESTIMATING RESPONSE OF DON RIVER TO WATER QUALITY CONTROL
3. SUPPORTING DOCUMENT NO. 2: FRAMEWORK FOR EVALUATING RESPONSE OF AQUATIC TOXICITY AND FISH HABITAT TO WATER QUALITY CONTROL IN THE DON RIVER
4. SUPPORTING DOCUMENT NO. 3 METHODOLOGY FOR EVALUATING IMPACTS OF SPILL REMEDIATION AND OTHER REMEDIAL OPTIONS UPON DON RIVER WATER QUALITY
5. SUPPORTING DOCUMENT NO. 4: PROBLEM DEFINITION: PRESENT STATE OF WATER QUALITY IN THE DON RIVER
6. SUPPORTING DOCUMENT NO. 5: ANALYSIS OF WATER QUALITY DATA FOR THE DON RIVER

**Availability of Reports**

Copies of the Supporting Documents and the Summary Report for the Strategy for Improvement of Don River Water Quality are available through the:

Public Information Centre
Water Resources Branch
135 St. Clair Avenue W.
Suite 100
Toronto, Ontario
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(416) 323-4321

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# TERMINOLOGY USED IN THIS DOCUMENT

This supporting document presents study findings developed during the initial phases of the study entitled "Strategy for Improvement of Don River Water Quality". The terminology presented in this document is oriented towards assessing the information base available for establishing a "Water Quality Management Plan" for the "Don River". In the subsequent phases of the study, the study objectives were reorientated towards developing a "strategy for water quality improvement", rather than a "management plan". The change in terminology is reflected in the Summary report and in Supporting Documents 1, 2, and 3.

A summary of the water quality characteristics of the Don River are given in this document. The potential sources of pollution and associated water quality problems are identified in the main body of this document.

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# 1.0 INTRODUCTION, OBJECTIVES AND STUDY AREA

## 1.1 Introduction

### 1.1.1 Purpose of Study

This report provides a problem definition of the state of water quality in the Don River. This is preparatory to developing a water quality improvement strategy for the Don River. In developing such a strategy, this study critiques the environmental engineering sciences, evaluates the various possible measures, and relates them to such criteria as:

- their effectiveness and the associated protection attained;
- their costs;
- their ease of implementation;
- their acceptance by the public;
- their rating by municipalities;
- their conflict potential; and
- their impact upon other environmental factors not considered directly.

The main emphasis in this study is to quantify the effectiveness of the different measures and the associated level of protection attained for water quality. A qualitative comparison to the other criteria described above is also made, but requires additional input from the concerned parties.

This study is one part of the overall TAWMS studies whose objective was to develop Water Quality Management Plans (WQMP) for the Humber River, the Don River, and Mimico Creek. The Ontario Ministry of the Environment (MOE) initiated a study of water quality in the Don River, Humber River and Mimico Creek in 1981 to provide baseline data to guide future studies. Subsequently, the Toronto Area Watershed Management Strategy Study (TAWMS) was formally organized. The objectives of TAWMS as outlined in the 1986 Report in the Humber Water Quality Management Plan:

- To better define water quality conditions within the study area;
- To analyse the cause and effect relationships for problem constituents and areas; and

- To develop cost-effective measures for controlling pollutant loadings to the study area's receiving waters based on watershed needs and uses.

### 1.1.2 Approach of Study

The approach of the overall study is to use existing water quality data, findings from other studies, and a simple method of analysis to evaluate the effectiveness of different remedial and mitigating measures in aid of developing the Don River Water Quality Improvement Strategy (WQIS).

To evaluate the effectiveness of the different control measures, present day flows and concentrations of different contaminants from different sources must be estimated. The instream concentrations resulting from these loads can then be calculated and compared to measured concentrations. Next, the effect of different control measures on the magnitude of source flow or source concentration and the associated costs are estimated. Finally, the impact of source control upon riverine concentrations can be calculated along with the costs related to level of protection of water quality.

Documentation on the Don River available to this study includes:

i) analysis of existing water quality, trends, and frequency of PWQO violations;
ii) a feasibility/scoping study of major problem areas;
iii) various technical documents detailing loadings from various sources and data compilation; and
iv) pollution control plans for two municipalities in Metropolitan Toronto (East York, Scarborough).

Where data are not available, literature values are used to estimate source concentrations. Relevant sources include TAWMS - Humber, NURP (National Urban Runoff Program of the US EPA), and European studies for stormwater runoff; MISA sampling for wastewater treatment plants, and Enhanced Monitoring Program data for rural and urban areas.

This study approach is different from that of the Humber. In the Humber, in-depth modelling studies of riverine response to different control options and in-depth studies of the costs and effectiveness of control options were made before development of the plan. In this study, a simple mass balance approach (loadings divided by dilution effects of the river) is used to assess riverine response.

The results of this approach must be viewed with caution. They are designed to be used in a management, planning sense, and in a relative sense rather than in a highly accurate, absolute sense. It is anticipated that in this broad-brush approach, additional in-depth modelling studies of riverine response may be needed in the future to improve the calculations given in this report.

### 1.1.3 Scope of this Supporting Document

In this Supporting Document, existing water quality is summarized, the "problem is identified" (Section 2), and the "objectives of the strategy" are identified (Section 3). A detailed characterization of existing water quality is presented in Supporting Document 5.

## 1.2 Objectives

The objectives of the Water Quality Improvement Strategy, as outlined in the Terms of Reference (see Appendix 1), are:

i) Identify the water quality problems within the Don River.
ii) Relate these problems to sources.
iii) Suggest reasonable mitigative options and associated cost estimates.
iv) Develop a Water Quality Management Plant (WQMP).

## 1.3 Study Background and Outline

Several studies on the Don River have already been completed. One study of note; the Phase I - Don River Water Quality Management Study (Cumming Cockburn, 1987) provided the following:

i) an annotated bibliography of all the Don River technical reports;

ii) a summary of comments from 14 institutional stakeholders located within the watershed;

iii) draft terms of reference for the study;

iv) an overview of the existing water quality within the Don River.

The study terms of reference did not involve detailed computer modelling to establish water quality conditions or evaluate remedial alternatives. Rather, existing data from the Don River and findings from other studies (principally the Humber River, Rouge River and United States National Urban Runoff Program, NURP) are used, together with a simplified analysis.

The river is divided into 11 reaches and tributaries (see Section 2.1). For each reach, potential levels of protection are identified. These levels, are identified by Cumming Cockburn (1987) in ascending order, as:

i) status quo;

ii) aesthetic improvements and limited water quality improvement;

iii) urban sport fisheries/non-body contact recreation;

iv) body contact recreation;

v) achievement of the Provincial Water Quality Objectives (PWQO).

One of the tasks of this study has been to better define the feasible levels of usage for each reach based on existing water quality data and a review of viable remedial alternatives.

In assessing the potential level of protection for water quality, several beneficial water uses and bases for environmental regulation and associated water quality parameters which are associated with these uses, have been identified. These include:

- swimming - bacteria;
- canoeing - water clarity (turbidity, presence/absence of oil spills);
- human health - drinking water concern (parameters to be defined, whether water is treated or incidentally swallowed during swimming needs to be defined);
- aesthetics - water clarity
  - presence/absence of odours and oil slicks/scum
  - frequency of spills
- fish - suspended solids
  - spills
  - ammonia
  - temperature

A considerable emphasis is placed on estimating the impact of water quality control on the existing fish population within the river and determining whether the habitat can be maintained or improved to accommodate additional species of fish.

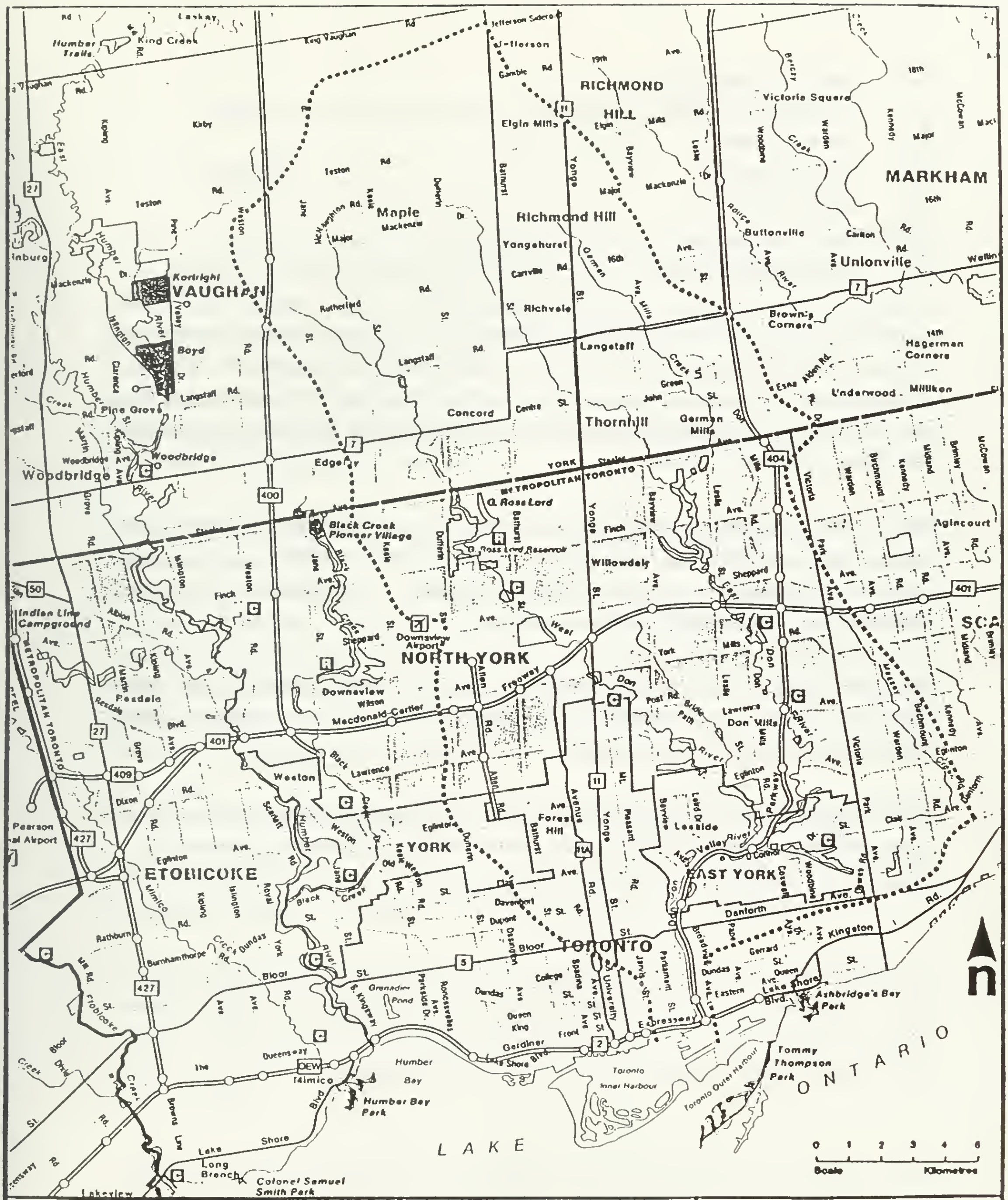
Furthermore, the water quality improvement strategy, if it is to be a viable one, must consider both existing and future conditions. The potential impact of future development, which is primarily located adjacent to the headwaters, will be discussed.

### 1.4 Description of the Study Area

The drainage area of the watershed is approximately 355 square kilometres. The headwaters originate in the Oak Ridges moraine and flow southerly for a distance of 38 kilometers prior to discharging to Lake Ontario (Figure 1). The river is comprised of two main branches which join south of Eglinton Avenue and several tributaries including Massey Creek and Wilket Creek.

There are ten municipalities which are located within the Don River watershed. The ten municipalities are:

i) Borough of East York,
ii) Town of Markham,
iii) City of North York



DON RIVER WATERSHED
FIGURE 1

----WATERSHED BOUNDARY

iv) Town of Richmond Hill,
v) City of Scarborough,
vi) City of Toronto,
vii) Town of Vaughan,
viii) City of York,
ix) Region of York, and
x) Metropolitan Toronto.

In general terms development originated adjacent to the lake and spread northerly and easterly, crossing Highway 401 in the 1950's. Under present day conditions a majority of the watershed is developed (72 percent). A further 10 percent of the watershed, using current official plans, will be developed. The remaining 18 percent is comprised of valleyland, parks or rural property.

Three of the municipalities, Scarborough, Toronto, and East York, have combined sewer systems which service older parts of the municipalities. In total, approximately 7 percent of the watershed is serviced by combined sewers. Sixty-three (63) percent of the watershed is serviced by storm sewer drainage.

The North Toronto STP services a portion of the lands located within the Don River watershed. This facility, which is located south of Bloor Street (Danforth Road) discharges its effluent to the Don River.

Other characteristics of note include the older heavy industry located in the down stream the watershed and the landfill sites within the watershed (see discussion below).

## 2.0 OVERVIEW OF SOURCE OF CONTAMINANTS TO THE DON RIVER

### 2.1 Introduction

There are several potential sources of pollutant inputs to the Don River. These sources may contribute pollutant loadings during dry or wet weather periods, or both. A list of the potential sources, together with the periods during which they contribute loadings is given in Table 2.1.

The North Toronto STP is a major and continuous source of pollution to the Don River at its point of discharge. Sewage bypasses, which occur during significant rainfall events contribute further loadings to the system.

Storm sewer discharges have been found to be a major source of many pollutants to the receiving waters (NURP, 1983; Driscoll, 1986). During dry weather periods pollution discharges may result due to seepage or infiltration, localized inputs (oil from cars, cleaning of vehicles, washing of pollutants from driveways or roads, etc.) or cross-connections between the storm and sanitary sewer systems. Cross-connections may be either direct or indirect (i.e., transferral of flows from one sewer to another through the bedding material). Pollutant loadings during wet weather events is more widespread and is generally associated with the washoff of pollutants from the surface.

Combined sewer overflows generally occur many times a year. They are a result of the flows which are in excess of a defined multiple of the dry weather flow being spilled to the receiving body of water. Present assessments of the study (see Supporting Document 1) suggest that they occur 30% of the time in the lower reaches of the Don.

Spills may emanate from various sources including tanker trucks which overturn, industrial spills, individuals dumping oil or gasoline into the sewer system etc. This process is random and hard to quantify. However, they tend to occur more frequently than is commonly acknowledged (MOE, Humber River, 1986) and may therefore pose a serious concern.

Snow dumps, especially those located adjacent to the watercourse, act as point source loads (e.g., metals, organic compounds) to the receiving body.

## TABLE 2.1: POTENTIAL SOURCES OF POLLUTANT LOADINGS TO THE DON RIVER

| | Periods During Which Loadings May Occur | |
|---|---|---|
| Source | Dry | Wet |
| North Toronto STP Effluent | X | X |
| North Toronto STP Bypasses | | X |
| Storm Sewer Discharges | X | X |
| Seepage/Infiltration | X | |
| Cross Connections | X | X |
| Combined Sewer Overflow | | X |
| Spills | X | X |
| Snow Dumps | X | X |
| Industrial Discharges | X | X |
| Landfill Sites | X | X |
| Agricultural Sources | X | X |
| Stream Bank Erosion | | X |
| Urbanization | X | X |
| Construction Activities | | X |
| Atmospheric Fallout | X | X |

Industrial discharges to the storm sewer may be a source of various water quality parameters, including toxic substances.

Landfill sites, through the leachate which infiltrates into the groundwater, also transfer pollutants to the receiving body.

Sources of pollution from agricultural areas are often underestimated. The sources may be a result of:

i) cattle access;
ii) intensive tillage to stream bank;
iii) tile drains;
iv) runoff from manure storage areas;
v) stream bank erosion.

Stream bank erosion will increase the suspended solids and turbidity levels within the receiving body. Urban development increases stream bank erosion due to the increases in peak flows and volumes of runoff.

Construction activities, if not properly carried out, significantly increase the sediment load to the receiving body.

Atmospheric fallout generally adds to the contaminant load in the river by direct loadings to the surface of the river, adds to the contaminant burden of soils in the watershed, and directly runs off to stream courses from pervious areas.

These sources are now examined in more detail.

## 2.2 North Toronto STP

The North Toronto STP is located approximately 12 kilometres north of Lakeshore Blvd. on the west bank of the Don River.

The plant is an activated sludge type which was constructed in two phases (1926 and 1928). The plant is rated at 7.5 mgd (0.349 cms). In recent years the plant has been operating at a controlled uniform rate of 7.5 mgd. Flows in excess of the controlled amount are conveyed by the North Toronto sanitary trunk sewer and ultimately to the Main Treatment Plant. The effluent from the North Toronto plant is disinfected (chlorinated) during summer months.

A sampling study (Canviro Consultants Ltd., 1984) evaluated the average dry weather concentrations, flows and, loadings of the STP effluent to the River. The values for the parameters which were considered by Canviro are shown in Table 2.2. The values given are based on the period July to December, 1986.

This report also points out the relative importance of the North Toronto STP with regard to total loadings to the Don River during dry weather periods. It provides:

- 24 percent of the flow
- 5 percent of suspended solids
- less than 1 percent of fecal coliform
- 7 percent of copper

A majority of the flows which exceed the plant capacity are diverted to the North Toronto sanitary trunk sewer and ultimately to the Main Treatment Facility. Overflows to the Don River do, however, occur relatively frequently (39 in 1986). The volume and concentration of the overflows are not known. The overflows are chlorinated prior to discharging to the river.

## 2.3 Storm Water Discharges

Storm water originates from storm sewers, minor tributaries and ditches. Loadings from storm sewers discharging during dry weather periods are augmented by cross-connections between the sanitary and storm sewers or combined and storm sewer systems.

### 2.3.1 Studies in Don River Watershed

Canviro Consultants Limited (1986) carried out an extensive dry weather outfall study during the late summer and fall seasons in 1984. The objectives of this study were to:

TABLE 2.2: POLLUTANT CONCENTRATIONS AND LOADINGS FOR THE NORTH TORONTO STP

| Parameter | Concentration | Loading* |
|---|---|---|
| Suspended Solids | 8.3 mg/L | 284,689 gm/day |
| Total Phosphorus | 0.8 m/l | 28,126 gm/day |
| Fecal Coliform | 3.4 org/100 ml | 1.35 x $10^5$ org/sec. |
| Zinc | 0.07 mg/L | 2,401 gm/day |
| Copper | 0.04 mg/L | 1,372 gm/day |
| Lead | .04 mg/L | |
| Chlorides | N/A** | |
| DO | 7 mg/L*** | |
| $BOD_5$ | 14.7 mg/L | |
| TKN | 6 mg/L*** | |
| Ammonia | 5 mg/L** | |
| **Representative Organics** | | |
| Methoxychlor | N/A | |
| Lindane | N/A | |
| Reactive Phenolics | N/A | |
| PCP | N/A | |

* From reference. Loadings for period July to December, 1986.

N/A Not available from Canviro study.

*** Values assumed

i) carry out an inventory to document all existing outfalls;

ii) assess the loadings and concentrations of selected contaminants discharging in dry weather from all existing outfalls;

iii) identify and prioritize outfalls discharging contaminants with concentrations in excess of "modified sewer use bylaw limits".

In total, 1185 storm sewers, 112 tributaries and 96 drainage ditches were sampled. Outfalls exceeding modified Metropolitan Toronto sewer bylaws and having a minimum of 4 results for a given parameter were classified as being in Group A. It was recommended that these outfalls (156 in total) be investigated further by the respective municipalities. Subsequently, work was carried out on the second set of outfalls called "Group B". They have been, or are being classified as either "A"'s or not relevant.

The Canviro study also determined the total loadings on a reach by reach basis (22 reaches in total) for many parameters. As stated in the report, the accuracy of the loadings are within an order of magnitude due to the methods used for sampling both flow and concentration.

The findings from the outfall survey showed that individual outlets resulted in a significant portion of the total pollutant input. For example, individual outlets discharged:

- 36 percent of the total suspended solids loading;
- 79 percent of the total phosphorus loading; and
- 38 percent of the total phenol loading.

No reasons for the high concentrations from the priority outfalls was given. Possible sources could be cross-connections, industrial discharges, leachate from landfills, spills, etc. Based on a report from the MOE Central Office, only a few of the priority outfalls (from the City of Toronto) have been removed from the priority list.

Trace metals may be exported from the developed basin as part of the material washed from roadways and parking lots. Metals such as arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, lead, selenium, thallium and zinc have been measured. With the exception of lead, cadmium, copper and zinc, they are all found in very low concentrations. These four metals, which are found in appreciable quantity, are frequently measured at concentrations greater than those recommended for protection of aquatic life. The metals originate from normal anthropogenic activity, with the greatest quantity of lead emanating from automobile exhaust. Most of these metals are associated closely with sediments and settle to the bottom of streams in slow moving reaches. Therefore, they are not readily available for uptake by aquatic organisms unless they feed upon the sediments. Sediment species may be more affected than water column species.

Urban runoff has frequently been found to be a significant source of pollution (NURP, 1983; Driscoll, 1986). Determination of the loadings from urban areas are therefore important as a vast majority of the Don River watershed is serviced by separate sewers. Loadings from undeveloped or rural areas are also important, if they constituent a large enough area.

Estimates of loadings from Scarborough and East York have been established in two previous PCP studies (Proctor & Redfern, 1987; Gore & Storrie Ltd., 1987). However, the estimates were based on computer analyses without the benefit of any monitored data to calibrate/validate the model.

Monitoring data from four sub-catchments are available at (see Figure 1):

i) York Mills,
ii) Dallington Park,
iii) Ramsden Park, and
iv) Chesswood.

Table 2.3 gives the drainage area, land use, sewershed type (storm or combined sewer overflow) and number of monitored events (wet weather, flow and concentration).

These data are currently being processed by MOE staff.

TABLE 2.3: URBAN FLOW MONITORING AND SAMPLING CATCHMENT

| Catchment Name | Area (ha) | Location | Land Use | Sewer System | No. of Events |
|---|---|---|---|---|---|
| York Mills* | 1,050 | North York | Res. Comm. | Storm | 0** |
| Dallington Park | 313 | North York | Res. Comm. | Storm | 2** |
| Ramsden Park | 272 | City of Toronto | Res. Comm. | CSO | 10 |
| Chesswood | 4141 | North York | Indust. Resid. | Storm | 10 |

*Flow monitoring data are available
**Events are monitored but data need to be retrieved

### 2.3.2 Studies for TAWMS - Humber River

A detailed determination of the number of outfalls discharging to the Humber River was undertaken. Many of these were observed to have flow during dry weather periods, indicating the presence of either illegal or industrial connections. The loadings attributed to these dry-flowing outfalls were large (Table 2.4), suggesting the need for programs to control them. It is clear from the table that BOD, and suspended solids contributions were high in these outfalls. However, other materials, notably lead, zinc and chromium were also significant.

Studies were carried out in two pilot catchments to determine the characteristics of dry weather flows. Two landuse types were studied. Both residential and industrial landuse types were studies in these pilot catchments. The results of the baseflow characterization studies indicated that concentrations of solids, and coliform bacteria were high from both types of landuse. The industrial sector produced higher nutrient levels than the residential component (Table 2.5). Annual loadings from the two types of landuse followed the same pattern. The estimated annual loadings from each of the pilot catchments showed that a large portion of the solids and coliform loadings result from baseflow conditions (Table 2.6). However, the contribution of other substances from stormwater ranged from 50 to 60 percent of the total annual loading in the residential and the industrial areas.

## TABLE 2.4: AVERAGE DAILY DRY WEATHER STORM SEWER LOADS (After MOE (1986) TAWMS Humber River Water Quality Management Plan

| Parameter | Total Outfall Loading (kg/d) |
|---|---|
| TKN | 59 |
| $NH_3$ | 21 |
| $NO_3$ | 15 |
| Total P | 21 |
| BOD | 351 |
| COD | 1800 |
| Phenol | 0.3 |
| SS | 1681 |
| Pb | 1.5 |
| Cu | 0.4 |
| Cr | 3.6 |
| Zn | 12.3 |
| Hg | 0.1 |

These results indicate that the loadings to receiving streams due to urban stormwater runoff are large in the Humber River because of both dry and wet weather flows. Major dry weather flows are attributed to industrial sources in the Humber, however, large inputs are also attributed to residential landuse.

In future developments of the Don River, the opportunity exists to reduce the impact of industrial connections to storm sewers by using development controls. However, the concentrations which might be expected from residential landuses are significant in terms of the Provincial Water Quality Objectives (PWQO), as shown in Table 2.7, which compares the baseflow concentrations with the PWQO's. These higher concentrations will result in increasing concentrations in the downstream receiving water.

### 2.3.3 Literature Studies

Literature data also provide a source of estimating water quality from storm sewer discharge.

Site mean concentrations for the various parameters are available from the United States National Urban Runoff Program (NURP) in which data from 28 sites was collected. The findings are compared to other watersheds within Southern Ontario in the main body of this report and found to be consistent. Equivalent Southern Ontario data include Brucewood, a sub-catchment within North York.

A summary of the Event Mean Concentrations for the various urban land uses is given in Table 2.8. Estimates for Agricultural sources are also given.

A more detailed analysis of the NURP data is given in Table 2.9. These data are now discussed.

The NURP study involved chemical/biochemical measurements of water quality constituents in runoff from 28 urban and rural sites in the U.S. over a period of 5 years. During this time, approximately 2300 separate storm events were monitored in 81 uncontrolled sites in 22 cities for a variety of pollutants, to determine the variation in the concentrations of each. The data were evaluated on a national basis and several important conclusions were drawn.

TABLE 2.5: PILOT CATCHMENT BASEFLOW CHARACTERISTICS (MOE, 1986)

| | Median Concentrations | | | | Estimated Annual Discharge | | |
|---|---|---|---|---|---|---|---|
| Parameter | Units | Thistledown* | Emery** | Bylaw+ | Units | Thistledown | Emery |
| Total residue | mg/L | 979 | 554 | - | kg/ha | 2,230 | 1,520 |
| Filterable residue | mg/L | 973 | 454 | - | - | - | - |
| Particulate residue | mg/L | LT 5 | 43 | 15 | - | - | - |
| Total Phosphorus | mg/L | 0.09 | 0.73 | 1.0 | g/ha | 206 | 2,000 |
| TKN | mg/L | 0.9 | 2.4 | 0 | g/ha | 2,060 | 6,580 |
| Phenolics | mg/L | LT 1.5 | 2.0 | 0.02 | mg/ha | LT 3,400 | 5,490 |
| COD | mg/L | 22 | 108 | - | kg/ha | 50 | 296 |
| Fecal Coliform | #/100 mL | 33,000 | 7,000 | - | $10^9$ org/ha | 754 | 192 |
| Fecal Strep | #/100 mL | 2,300 | 8,800 | - | - | - | - |
| Chromium | mg/L | LT 0.06 | 0.42 | 1.0 | g/ha | LT 140 | 1,150 |
| Copper | mg/L | 0.02 | 0.045 | 1.0 | g/ha | LT 90 | LT 100 |
| Lead | mg/L | LT 0.04 | LT 0.04 | 1.0 | g/ha | LT 90 | LT 100 |
| Zinc | mg/L | 0.04 | 0.18 | - | g/ha | 91 | LT 5.5 |

* Thistledown - 85% residential, 15% commercial landuse

** Emery - industrial landuse

+ Metropolitan Toronto Sewer Use Bylaw

LT Less than

TABLE 2.6: PILOT CATCHMENT ESTIMATED ANNUAL POLLUTANT DISCHARGES
(After MOE, 1986)

| | | THISTLEDOWN | | | EMERY | | |
|---|---|---|---|---|---|---|---|
| Constituent | Units | Base-Flow | Storm-Water | Total | Base-Flow | Storm-Water | Total |
| Total Solids | kg/ha | 2,230 | 297 | 2,530 | 1,520 | 821 | 2,340 |
| Total Phosphorus | g/ha | 206 | 352 | 558 | 2,000 | 1,630 | 3,630 |
| TKN | g/ha | 2,060 | 3,410 | 5,470 | 6,580 | 4,160 | 10,700 |
| Phenolics | mg/ha | LT 3,400 | 1,510 | 1,510-4,910 | 5,490 | 9,870 | 15,400 |
| COD | kg/ha | 50 | 62 | 112 | 296 | 212 | 508 |
| Chromium | g/ha | LT 140 | 25 | 25-165 | 1,150 | 730 | 1,880 |
| Copper | g/ha | 46 | 36 | 82 | 123 | 144 | 267 |
| Lead | g/ha | LT 90 | 50 | 50-140 | LT 100 | 210 | 210-310 |
| Zinc | g/ha | 91 | 90 | 181 | 494 | 530 | 1,020 |
| Fecal Coliforms | $10^9$ org/ha | 754 | 580 | 1,330 | 192 | 925 | 1,120 |

LT Less than

## TABLE 2.7: OUTFALL BASE FLOW CONCENTRATIONS COMPARED TO PWQO'S (MOE, 1986)

| Parameter | Units | Median Concentrations<br>Thistledown* | Emery** | Provincial Water Quality Objectives |
|---|---|---|---|---|
| Total residue | mg/L | 979 | 554 | - |
| Filterable residue | mg/L | 973 | 454 | - |
| Particulate residue | mg/L | LT 5 | 43 | - |
| Total Phosphorus | mg/L | 0.09 | 0.73 | 0.30 |
| TKN | mg/L | 0.9 | 2.4 | - |
| Phenolics | mg/L | LT 1.5 | 2.0 | 0.001 |
| COD | mg/L | 22 | 108 | - |
| Fecal Coliform | #/100 mL | 33,000 | 7,000 | 100 (swimming) |
| Fecal Strep | #/100 mL | 2,300 | 8,800 | - |
| Chromium | mg/L | LT 0.06 | 0.42 | 0.1 |
| Copper | mg/L | 0.02 | 0.045 | 0.005 |
| Lead | mg/L | LT 0.04 | LT 0.04 | 0.005-0.025 |
| Zinc | mg/L | 0.04 | 0.18 | 0.030 |

Before describing the conclusions it is necessary to present an important concept arising from the summary of the NURP study to assist in the evaluation of the data. The Event Mean Concentration concept (EMC) was developed to provide a single number characterization of the runoff behaviour of a site. EMC equals the total mass of the pollutant discharged during a storm runoff event, divided by the total volume of runoff generated by the precipitation event. It may therefore be considered as a flow weighted mean pollutant concentration for the storm event.

From the data collected during multiple storm runoff events in the different sites (i.e. different sewer catchments) it was clear that EMC's varied from event to event for the same site. Accordingly, a measure of this concentration and its variability was required. Most of the EMC data from one site fit a log normal probability distribution. The site mean concentration (SMC) was derived from the probability distribution to characterize the typical concentration from the site for all events. The Coefficient of Variation (CV), equal to the standard deviation divided by the mean (the SMC), was used to describe the variability of the water quality of each site.

## Conventional Pollutants

An extensive analysis of the probability distributions and the similarities of the 28 sites are summarized in Table 2.9. NURP results indicate that because of the wide confidence limits (high variability) on the SMC's from a given site, there was no significant relationship between geographic location and the quality of the storm runoff. Perusal of the table reveals that the SMC's for the various land uses do not differ substantially among categories. After evaluating the statistics of the differences, it was concluded that for the purposes of overall characterization of storm runoff, it was appropriate to group all of the landuse categories into one type with the characteristics given in Table 2.10. These results are particularly pertinent to this study. They suggest that for open/non-urban areas, the runoff concentrations are similar to those from urban areas. However, whether "non-urban" means agricultural areas is not clear from the description of the area.

Coliform data were collected in fewer locations than the conventional parameter monitoring. This may reflect a difference in perspective in the U.S. relative to Canada or logistical factors for analysing microbiological parameters relative to the logistics of

## TABLE 2.8: URBAN RUNOFF EVENT MEAN CONCENTRATIONS FOR VARIOUS WATER QUALITY PARAMETERS

| Parameter | Residential | Mixed | Commercial | Rural |
|---|---|---|---|---|
| Suspended Solids[1] | 101 | 67 | | 70 |
| Chlorides | | | | |
| Total Phosphorus[1] | 0.383 | 0.263 | 0.201 | 0.121 |
| Fecal Coliforms[2,3] | $5 \times 10^3$ | $5 \times 10^3$ | $5 \times 10^3$ | 300 |
| Zinc[1] | 0.135 | 0.154 | 0.226 | 0.195 |
| Copper[1] | 0.033 | 0.027 | 0.029 | 0.003 |
| Lead | | | | |
| DO | | | | |
| BOD | | | | |
| TKN | | | | |
| Ammonia | | | | |
| Atrazine | LTD | LTD | LTD | 10 ng/L[6] |
| Methoxychlor | ? | 900 ng/L[4] | ? | ? |
| Lindane | ? | ? | ? | ? |
| Reactive Phenolics | ? | 23 ug/L[5] | ? | ? |
| PCP | ? | ? | ? | ? |

NOTES

a) Allunits mg/L except fecal coliforms (org/100 ml)
b) 1 = NURP data
c) 2 - MOE, PCP guidelines
d) 3 = Rural from monitoring data for agricultural catchment at Steeles Avenue
e) LTD = less than detection
f) 4: Snowmelt value
g) 5: Two stormwater events from Stormwater Sampling Program
h) 6: Agricultural data from Nissouri watershed (BEAK, 1987)
i) ?: Not Available

TABLE 2.9: MEDIAN SMCs FOR ALL SITES BY LAND USE CATEGORY (U.S. EPA, 1983)

| Pollutant | | RESIDENTIAL | | MIXED | | COMMERCIAL | | OPEN/NON-URBAN | |
|---|---|---|---|---|---|---|---|---|---|
| | | Median | CV | Median | CV | Median | CV | Median | CV |
| BOD | mg/L | 10.0 | 0.41 | 7.8 | 0.52 | 9.3 | 0.31 | - | - |
| COD | mg/L | 73 | 0.55 | 65 | 0.58 | 57 | 0.39 | 40 | 0.78 |
| TSS | mg/L | 101 | 0.96 | 67 | 1.14 | 69 | 0.85 | 70 | 2.92 |
| Total Lead | ug/L | 144 | 0.75 | 114 | 1.35 | 104 | 0.68 | 30 | 1.52 |
| Total Copper | ug/L | 33 | 0.99 | 27 | 1.32 | 29 | 0.81 | - | - |
| Total Zinc | ug/L | 135 | 0.84 | 154 | 0.78 | 226 | 1.07 | 195 | 0.66 |
| Total Kjeldahl Nitrogen | ug/L | 1900 | 0.73 | 1288 | 0.50 | 1179 | 0.43 | 965 | 1.00 |
| $NO_2$-N + $NO_3$-N | ug/L | 736 | 0.83 | 558 | 0.67 | 572 | 0.48 | 543 | 0.91 |
| Total P | ug/L | 383 | 0.69 | 263 | 0.75 | 201 | 0.67 | 121 | 1.66 |
| Soluble P | ug/L | 143 | 0.46 | 56 | 0.75 | 80 | 0.71 | 26 | 2.11 |

metal analysis. Therefore, the data resulting from the study are limited. The results are useful, however, in that once again no difference in coliform export concentrations were identified due to landuse categories within urban areas. It is interesting to note that the only difference identified was a seasonal difference. Warm weather values were found to be generally higher than those observed in cold weather (Table 2.11). It is not clear whether or not any significant snow cover was related to the cold weather results. However, judging by the locations of the 7 cities involved, little snow is likely.

The NURP program concluded that the seasonality of the coliform data was not related to differences in urban activities, but rather than seasonal temperature effects and coliforms of non-fecal origin, and/or of animal origin may be important.

## Priority Pollutants

In general, few toxic organic chemicals data for stormwater are available. A Washington (D.C.) found two organic chemicals in storm water runoff, although limited data are available. In Washington, 10 pesticides (Aldrin, alpha-BHC, Beta-BHC, Lindane, Gamma-BHC Chlordane, DDE, DDT, Dieldrin, alpha-Endosulfan, Heptachlor, Heptachlor epoxide, Isophorane) were detected at concentrations near the analytical limits of detection. Other pollutants found included phthalates, phenols and creosols, but all were usually at concentrations well below the relevant guidelines.

A wide variety of priority pollutants were detected in runoff from urban sites in the NURP program. The most frequently detailed priority pollutants are shown in Table 2.12. In general, the inorganic pollutants were encountered much more frequently than the organic parameters. The most commonly observed organic pollutants were a plasticizer (Bis (2-ethylhexyl) phthalate) and a pesticide (a-hexachlorocyclohexane) which were noted in less than 30% of the samples. In contrast, lead, zinc and copper were present in more than 90% of the NURP samples.

The data collected illustrated frequent exceedances of surface water quality criteria when measured at the end of the pipe. However, these quality exceedances showed no relation to the prevalent conditions in the receiving stream.

## TABLE 2.10: WATER QUALITY CHARACTERISTICS OF URBAN RUNOFF (U.S. EPA, 1983)

| Constituent | Event to Event Variability in EMC's (Coef Var) | Site Median EMC<br>For Median Urban Site | <br>For 90th Percentile Urban Site |
|---|---|---|---|
| TSS (mg/L) | 1-2 | 100 | 300 |
| BOD (mg/L) | 0.5 - 1.0 | 9 | 15 |
| COD (mg/L) | 0.5 - 1.0 | 65 | 140 |
| Tot. P (mg/L) | 0.5 - 1.0 | 0.33 | 0.70 |
| Sol. P (mg/L) | 0.5 - 1.0 | 0.12 | 0.21 |
| TKN (mg/L) | 0.5 - 1.0 | 1.50 | 3.30 |
| $NO_{2+3}$-N (mg/L) | 0.5 - 1.0 | 0.68 | 1.75 |
| Tot. Cu (ug/L) | 0.5 - 1.0 | 34 | 93 |
| Tot. Pb (ug/L) | 0.5 - 1.0 | 144 | 350 |
| Tot. Zn (ug/L) | 0.5 - 1.0 | 160 | 500 |

TABLE 2.11: FECAL COLIFORM CONCENTRATIONS IN URBAN RUNOFF (U.S. EPA, 1983)

| Project and Site | | State | Landuse | Site No. Obs | Median EMC (1000/ 100 mL) | C.V. | Site No. Obs | Median EMC (1000/ 100 mL) | C.V. |
|---|---|---|---|---|---|---|---|---|---|
| DC1 | Burke | Washington |  | 1 | 4.6 | - | 1 | 0.02 | - |
|  | Westleigh | D.C. | Residential | 1 | 46 | - | 2 | 0.35 | - |
|  | Stedwick |  | Residential | 2 | 10 | - | 1 | 0.2 | - |
| MD1 | Homeland | Maryland | Residential | 7 | 11 | 1.8 | - | - | - |
|  | Mt. Wash |  | Residential | 1 | 130 | - | 1 | 3.3 | - |
|  | Res Hill |  | Residential | 1 | 281 | - | 1 | 330 | - |
| NC1 | (CBD) 1013 | North | Commercial | 11 | 15 | 1.6 | 8 | 1.0 | 0.6 |
|  | Res 1023 | Carolina | Residential | 2 | 23 | - | 4 | 2.6 | 1.1 |
| NH1 | Pkg. Lot | New Hampshire | Commercial | 20 | 0.3 | 0.5 | - | - | - |
| NY1 | Carll | New York | Residential | 12 | 24 | 0.9 | 15 | 1.4 | 1.5 |
|  | Unqua |  | Residential | 7 | 11 | 1.6 | 4 | 0.9 | 14 |
| SD1 | Meade | South Dakota | Mixed | 9 | 57 | 0.7 | - | - | - |
| TN1 | CBD | Tennessee | Commercial | 7 | 54 | 1.5 | 7 | 1.0 | 1.4 |
|  | R1 |  | Residential | 6 | 56 | 2.0 | 4 | 1.6 | 1.9 |
|  | R2 |  | Residential | 6 | 19 | 6.2 | 4 | 0.5 | 2.4 |
|  | SC |  | Mixed | 7 | 12 | 2.8 | 4 | 0.9 | 1.7 |
|  |  |  |  | 76 Events |  |  | 52 events |  |  |
| All Sites |  | Notes: |  | 11 | 21 | 0.8 | 9 | 1 | 0.7 |

*For general characterization of urban runoff, exclude the following sites:

- NH1 - A small (0.9A) Parking Lot; concentrations low and atypical
- Four sites with only one observation for season; variability is too high for any confidence in representativeness of a single value

## 2.4 Combined Sewer Overflow Loadings

The Cities of Scarborough and East York have areas which are serviced by combined sewers.

In the City of Scarborough the area bounded by Victoria Park, Eglinton Avenue, Midland Avenue, and Lake Ontario is predominantly combined (see Figure 1). In total there are 60 overflows or spillovers within the City.

A Pollution Control Plan Study for this municipality was carried out in 1986-1987 (Proctor & Redfern, 1987). The relevant findings of this study are as follows:

i) In total, seven overflows (three to Lake Ontario and four to Massey Creek), contribute 98 percent of the pollutant loadings from combined sewer overflows.

ii) The Massey Creek overflows are located at Pharmacy (M1), Danforth and Mach (M6), Godfrey-Fowler (M4) and at Warden and Hymes (M10) (Figure 1).

iii) For a specific rainfall event (4.09 mm precipitation in 2.63 hours) the combined sewer overflow volume from the four major overflows to Massey Creek is approximately 8,500 $m^3$. This value increases to approximately 45,000 $m^3$ for a 2 year event.

The report also presents annual loadings for each overflow. The parameters included in the analysis are: total suspended solids, biochemical oxygen demand, total phosphorus, fecal coliform, lead, copper and zinc. It should be noted, however, that the loadings were not verified based on any monitoring data.

A majority of the sewer system within the Borough of East York consists of combined sewers with the exception of the area north of Massey Creek and the northeast portion of the former Town of Leaside (Figure 1).

A Pollution Control Plan Study for this municipality was also carried out in 1986-1987 (Gore & Storrie Ltd., 1987). In summary, the findings were as follows:

## TABLE 2.12: MOST FREQUENTLY DETECTED PRIORITY POLLUTANTS IN NURP URBANRUNOFF SAMPLES[1] (U.S. EPA, 1983)

### Priority Pollutants Detected in 75 Percent or More of the NURP Samples

Inorganics

30. Lead (94%)
36. Zinc (94%)
28. Copper (91%)

Organics

None

### Priority Pollutants Detected in 50 Percent to 74 Percent of the NURP Samples

Inorganics

27. Chromium (58%)
23. Arsenic (52%)

Organics

None

### Priority Pollutants Detected in 20 Percent to 49 Percent of the NURP Samples

Inorganics

26. Cadmium (48%)
32. Nickel (43%)
29. Cyanides (23%)

Organics

105. -Endosulfan (19%)
3. -Hexachlorocyclohexane (20%)

### Priority Pollutans Detected in 10 Percent to 19 Percent of the NURP Samples

32. Antimony (13%)
29. Beryllium (12%)
33. Selenium (11%)

94. Pentachlorophenol (19%)
7. Chlordane (17%)
5. -Hexachlorocyclohexane (Lindane) (15%)
122. Pyrene (15%)
90. Phenol (14%)
121. Pyrene (15%)
47. Dichloromethane (methylene chloride) (11%)
96. 4-Nitrophenol (10%)
115. Chrysene (10%)
117. Fluoranthene (16%)

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[1] Based on 121 sample results received as of September 30, 1983, adjusted for quality control review. Does not include special metals samples.

i) loadings were calculated on an event and annual basis, for suspended and settleable solids, biochemical oxygen demand, total nitrogen, orthophosphate and fecal coliforms;

ii) the models were calibrated to data from 1986 and 1979;

iii) estimated loadings to the receiving bodies are given at the outlet of three catchments (Cadorna, South-east Leaside North). The total estimated annual flow volume of overflows is 2,000 $m^3$.

## 2.5 Spills

In the TAWMS Humber River study it was estimated that spills occurred at least once per day (MOE, Humber River, 1986). Data received from the MOE (Wes Lammers,pers. comm.) also indicates frequent spills. The findings, which were reported to the MOE Spills Action Centre, suggest that the most frequent type of materials spilled are gasoline and oil. The occasional chemical spill (known or unknown material) was also reported.

Although spills may have serious consequences, they are virtually impossible to predict or quantify. The impact of spills are summarized in Supporting Documents 2 and 3. A special study was undertaken in this work to evaluate the phenomena of spills and their impact upon the environment.

## 2.6 Industrial Discharges

A previous report (R.V. Anderson, 1984) identified potential industrial users which may discharge pollutants directly to the storm or combined sewer systems. No further statement was given as to the likelihood of direct discharges.

This study made no attempt to quantify the potential impact from industrial sources as this is covered under the Municipal Industrial Strategy for Abatement of Pollution (MISA). Comments from municipal person involved in the spills evaluation study were used to establish the likelihood of industrial discharges being the source of pollutant discharges.

## 2.7 Snow Dumps, Landfill Sites, Agricultural Sources, Atmospheric Loadings

### Snow Dumps

The impact of snow upon river loadings has been long recognized, but not investigated in great detail. General studies (e.g., Ralston and Hamilton, 1978; O'Connor and Mueller, 1970) have characterized chloride inputs into Lake Ontario and the relative signficiance of road salts. Much snow is removed to dump sites; the advent of Metro-Toronto snowmelt machines has resulted in discharge of some snow directly to the storm sewers.

The metal levels of such snow were determined in a special TAWMS study. The results (see Table 2.12) compared to median Don River levels, indicate that all metals are substantially above ambient river levels with lead being the highest. Further work is required on the potential importance of this source of contaminants.

### Landfill Site

Few studies are available which characterize the impact of landfills on surface water quality. Such data gaps will need to be restricted in the future. One study of the impacts of landfills upon PCB and organochlorine Pesticides in the river basin did not demonstrate a substantial impact of the landfill on ambient river water quality (Figure 2.1); however, the approach of measuring river concentrations above and below the site makes establishment of landfill impacts difficult.

Additional study is required in the future to attempt to remedy this gap and for further development of a management plan.

### Agricultural Sources

Agricultural sources and developer owned, non-farmed land define the current water quality of the urbanizing fringe of the upper watershed.

Water quality of river systems draining agricultural areas is impacted by the density and type of agriculture use. The past level of agricultural use can be evaluated by examining data for York County (Table 2.13). The agricultural base is a mix of animals (using several crops) and monoculture (row crop). Unlike other areas of Southern Ontario which

TABLE 2.12: METALS CONCENTRATIONS IN METROMELT MACHINE EFFLUENTS

| Metal | Sample # 1 | 2 | 3 | Don R.* Median Level | Ratio |
|---|---|---|---|---|---|
| Iron (mg/L) | 27 | 35 | 85 | .73 | 37 - 116 |
| Chromium (ug/L) | 30 | 90 | 220 | 12 | 2.5 - 18 |
| Copper (ug/L) | 330 | 940 | 1,000 | 10 | 33 - 100 |
| Lead (ug/L) | 1,400 | 2,100 | 7,100 | 7 | 200 - 1,014 |
| Zinc (ug/L) | 1,200 | 1,500 | 3,000 | 25 | 48 - 120 |

*median concentrations of routine PWQMN samples at Lakeshore Blvd.

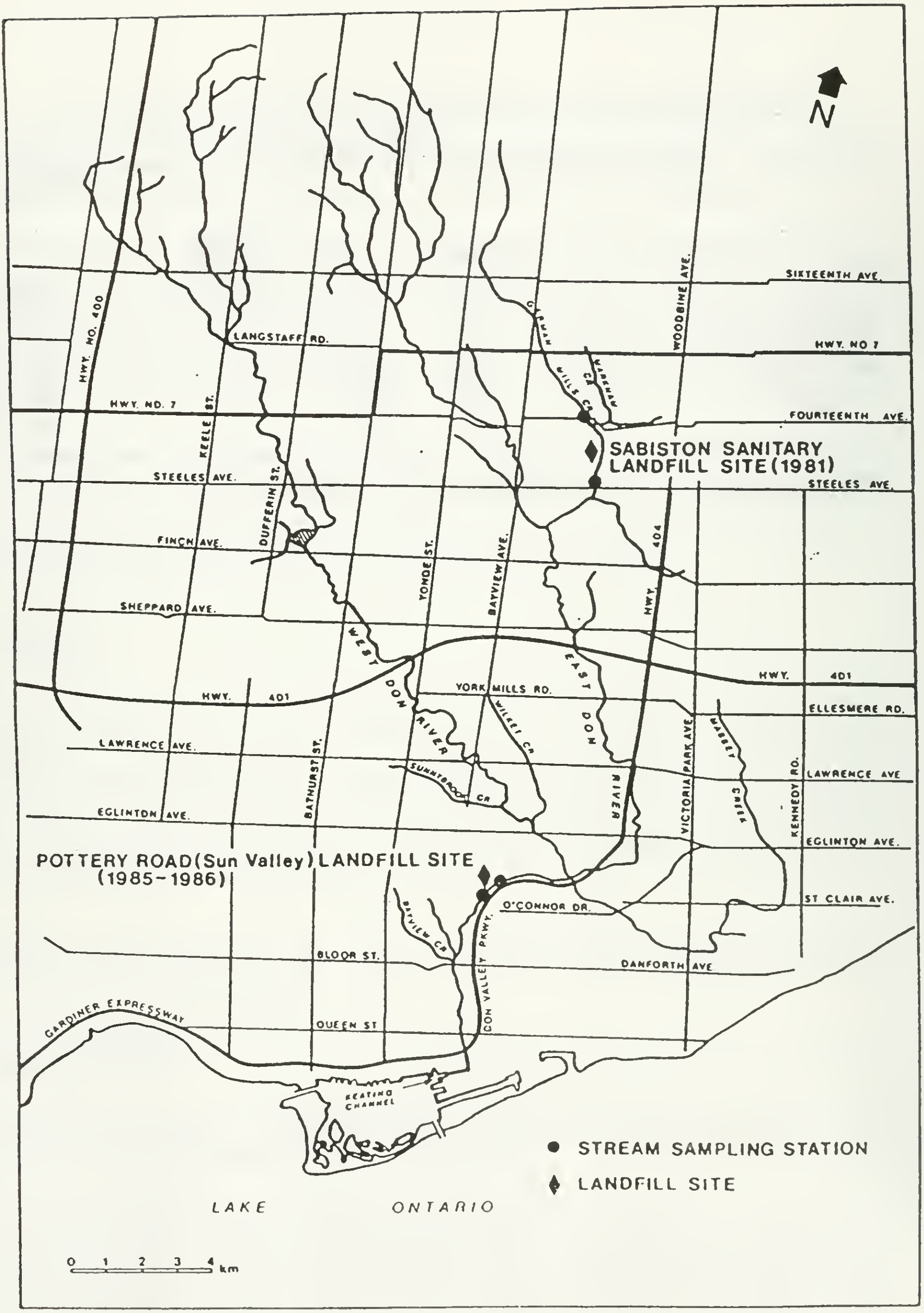

FIGURE 2.1: Landfill Site Sampling Programs for PCB and Organochlorine Pesticides - Don River and Tributaries

have converted almost exclusively to the more highly erosive environment of the row crop, a substantive portion of York Region agriculture uses grass and grain crops. This minimizes the amount of overland erosion.

Water quality derived from agricultural areas is a function of material added to the crop land (fertilizer, herbicides, pesticides), the erosion potential and land management. A data base describing the amount of agricultural chemicals used in the Don River watershed is not available. Data are not available from the PWQMN to define the water quality from rural areas of the upper watershed. Data from summer box plots of the agriculturally dominated catchment at Little Rouge River at Steeles and from the Upper Humber River study were used to define this water quality.

## Atmospheric Loading

Atmospheric loadings provide one of the major sources of contamination in stormwater runoff. They impact soil contamination burdens, provide direct loads to the river and indirect loads to river from impervious areas. Estimates of atmospheric loadings and concentrations are available from various studies. These sources cannot be controlled, but it is useful to know their values to provide a perspective upon runoff concentrations and loads.

Atmospheric deposition falls to the earth in two forms: wet fall and dry fall. Wet fall is material associated with rainfall events while dry fall represents settling material which accumulates between events. Some dry fall (e.g., particulate material) is derived from erosion of the watershed by winds while the remainder comes from transboundary wind transport. Typical concentrations measured in rainfall loadings from rainfall and dry fall in the Don River area are summarized in Table 2.14. The values are derived from nearby monitoring stations and are typical of Southern Ontario in this area. Site specific monitoring data are not available. The table does not include data for acidic precipitation (sulphate, $H^+$) because this was not a significant focus of this study.

Atmospheric deposition will have a small impact upon the actual quality of the Rouge River because the riverine surface waters represent a small portion of the total surface area of the watershed. Atmospheric deposition will have an increased impact on water quality as the watershed urbanizes because impervious areas will collect the deposition and route it to the river. These data also provide a reference for the condition of water

## TABLE 2.13: 1986 Census of Agriculture in York County (After OMAF Agricultural Statistics for Ontario, Publication No. 20)

| LAND USE: | ACRES | FARMS REPORTING |
|---|---|---|
| IMPROVED AREA | 166,286 | 1,345 |
| CROPLAND | 136,740 | 1,117 |
| SUMMERFALLOW | 7,182 | 197 |
| IMPROVED PASTURE | 14,336 | 436 |
| OTHER IMPROVED LAND | 8,028 | 877 |
| UNIMPROVED AREA | 44,318 | 866 |
| UNIMPROVED PASTURE | 18,407 | 476 |
| WOODLAND | 11,594 | 421 |
| OTHER UNIMPROVED LAND | 14,327 | 376 |
| TOTAL AREA | 210,604 | 1,391 |

| FIELD CROPS: | ACRES | FARMS REPORTING |
|---|---|---|
| WINTER WHEAT | 12,478 | 261 |
| SPRING WHEAT | 931 | 20 |
| FALL RYE | 170 | 9 |
| SPRING RYE | 0 | 0 |
| OATS FOR GRAIN | 1,460 | 78 |
| BARLEY FOR GRAIN | 12,615 | 225 |
| MIXED GRAINS | 8,189 | 224 |
| GRAIN CORN | 32,350 | 214 |
| SOYBEANS | 8,593 | 46 |
| CANOLA | 1,283 | 14 |
| FLAXSEED | x | 1 |
| TRITICALE | x | 4 |
| SUNFLOWERS | 222 | 4 |
| DRY FIELD BEANS | 309 | 14 |
| DRY FIELD PEAS | 0 | 1 |
| BUCKWHEAT | 206 | 6 |
| MUSTARD SEED | 0 | 0 |
| SILAGE CORN | 6,374 | 169 |
| TAME HAY | 35,109 | 746 |
| OATS FOR FODDER | 450 | 18 |
| BARLEY FOR FODDER | 368 | 12 |
| FORAGE SEED | 301 | 10 |
| TOBACCO | 0 | 0 |

| FRUIT CROPS: | ACRES | FARMS REPORTING |
|---|---|---|
| TREE FRUITS: | | |
| APPLES | 249 | 53 |
| PEARS | 8 | 21 |
| PLUMS AND PRUNES | 9 | 18 |
| SWEET CHERRIES | 4 | 7 |
| TART CHERRIES | 3 | 7 |
| PEACHES | x | 4 |
| APRICOTS | 1 | 4 |
| OTHERS | 0 | 3 |
| TOTAL | x | 54 |
| BERRIES AND GRAPES: | | |
| STRAWBERRIES* | 251 | 20 |
| RASPBERRIES* | 79 | 21 |
| GRAPES* | x | 3 |
| BLUEBERRIES* | . 0 | 0 |
| CRANBERRIES* | 0 | 0 |
| OTHER* | x | 3 |
| TOTAL | 365 | 34 |
| GRAND TOTAL | x | |

| VEGETABLES: | ACRES | FARMS REPORTING |
|---|---|---|
| ASPARAGUS* | 39 | 13 |
| BEANS | 81 | 39 |
| BROCCOLI | 149 | 26 |
| CABBAGE | 305 | 47 |
| CARROTS | 3,009 | 108 |
| CAULIFLOWER | 553 | 54 |
| CUCUMBERS | 34 | 31 |
| GREEN PEAS | 61 | 24 |
| LETTUCE | 538 | 41 |
| DRY ONIONS | 2,014 | 75 |
| POTATOES | 830 | 43 |
| RUTABAGAS | 0 | 3 |
| SWEET CORN | 509 | 56 |
| TOMATOES | 344 | 51 |

SELECTED CROPS CLASSIFIED BY ACREAGE (FARMS REPORTING)

| ACRES | WINTER WHEAT | OATS FOR GRAIN | BARLEY | MIXED GRAINS | GRAIN CORN | SOYBEANS | TOBACCO |
|---|---|---|---|---|---|---|---|
| 1-7 | 6 | 20 | 7 | 19 | 5 | 2 | 0 |
| 8-32 | 139 | 45 | 85 | 107 | 59 | 31 | 0 |
| 33-77 | 78 | 12 | 61 | 61 | 45 | 23 | 0 |
| 78-127 | 20 | 1 | 31 | 16 | 32 | 10 | 0 |
| 128 & OVER | 18 | 0 | 21 | 1 | 73 | 20 | 0 |

| CATTLE AND CALVES: | NUMBER | FARMS REPORTING |
|---|---|---|
| BULLS | 358 | 718 |
| DAIRY COWS | 5,439 | 156 |
| BEEF COWS | 4,533 | 316 |
| DAIRY HEIFERS | 2,721 | 143 |
| BEEF HEIFERS(BREEDING) | 916 | 165 |
| SLAUGHTER HEIFERS | 3,374 | 125 |
| STEERS | 4,814 | 208 |
| CALVES | 6,324 | 441 |
| TOTAL CATTLE/CALVES | 28,479 | 577 |

| PIGS: | NUMBER | FARMS REPORTING |
|---|---|---|
| BOARS | 170 | 89 |
| SOWS AND BRED GILTS | 2,167 | 101 |
| ALL OTHER PIGS: | | |
| UNDER 20 KG | 7,101 | 99 |
| 20 TO 60 KG | 7,634 | 108 |
| OVER 60 KG | 6,351 | 90 |
| TOTAL PIGS | 23,423 | 168 |

| SHEEP AND LAMBS: | NUMBER | FARMS REPORTING |
|---|---|---|
| RAMS | 107 | 56 |
| EWES AND WETHERS | 2,273 | 88 |
| LAMBS | 1,670 | 83 |
| TOTAL SHEEP AND LAMBS | 4,050 | 95 |
| GOATS | 548 | 59 |

| POULTRY: | NUMBER | FARMS REPORTING |
|---|---|---|
| HENS AND PULLETS, 20 WEEKS AND OVER | x | 200 |
| PULLETS AND CHICKS, UNDER 20 WEEKS | x | 42 |
| OTHER CHICKENS | 320,877 | 130 |
| TOTAL CHICKENS | 561,549 | 253 |
| TURKEYS | x | 23 |

| FARM MACHINERY: | NUMBER | FARMS REPORTING |
|---|---|---|
| FARM TRUCKS | 1,762 | 1,017 |
| TRACTORS | 3,631 | 1,234 |
| COMBINES | 363 | 324 |
| SWATHERS | 154 | 152 |
| BALERS | 630 | 555 |
| FORAGE HARVESTERS | 172 | 154 |

| SELECTED EXPENDITURES, 1985: | $ | FARMS REPORTING |
|---|---|---|
| RENT | 3,295,830 | 524 |
| WAGES TO LABOUR | 20,240,750 | 718 |
| FEED | 15,082,130 | 818 |
| SEED | 4,583,233 | 765 |
| FERTILIZER AND LIME | 5,198,045 | 824 |
| AGRICULTURAL CHEMICALS | 3,376,035 | 726 |
| CUSTOM WORK | 2,200,158 | 607 |
| MACHINERY EXPENSES | 10,651,480 | 1,211 |
| ELECTRICITY | 3,055,101 | 1,106 |
| HEATING FUEL | 2,086,945 | 538 |
| INTEREST | 7,224,384 | 542 |
| TOTAL EXPENSES | 124,882,400 | 1,388 |

SELECTED LIVESTOCK CLASSIFIED BY HERD SIZE (FARMS REPORTING)

| NUMBER OF HERD | DAIRY COWS & HEIFERS | BEEF COWS & HEIFERS | SLAUGHTER CATTLE | SOWS | OTHER PIGS OVER 20 KG | SHEEP & LAMBS |
|---|---|---|---|---|---|---|
| 1-7 | 31 | 127 | 154 | 36 | 29 | 73 |
| 8-32 | 41 | 169 | 72 | 47 | 29 | 41 |
| 33-77 | 67 | 34 | 20 | 12 | 29 | 17 |
| 78-177 | 29 | 5 | 9 | 6 | 18 | 10 |
| 178 & OVER | 3 | 0 | 10 | 0 | 26 | 4 |

| FARM SIZE: (ACRES) | FARMS REPORTING |
|---|---|
| UNDER 10 | 125 |
| 10-69 | 551 |
| 70-239 | 476 |
| 240-399 | 110 |
| 400-559 | 55 |
| 560-759 | 31 |
| 760-1,119 | 22 |
| 1,120-1,599 | 10 |
| 1,600 & OVER | 11 |

| AGE OF OPERATOR: | FARMS REPORTING |
|---|---|
| UNDER 25 | 18 |
| 25-34 | 148 |
| 35-44 | 251 |
| 45-54 | 373 |
| 55-64 | 360 |
| 65 YEARS & OVER | 241 |

| GROSS VALUE OF AGRICULTURAL PRODUCTS SOLD, 1985: | FARMS REPORTING |
|---|---|
| UNDER $2,500 | 251 |
| $2,500-$4,999 | 123 |
| $5,000-$9,999 | 187 |
| $10,000-$24,999 | 208 |
| $25,000-$49,999 | 159 |
| $50,000-$99,999 | 159 |
| $100,000-$249,999 | 174 |
| $250,000-$499,999 | 79 |
| $500,000 AND OVER | 41 |

GROSS VALUE OF AGRICULTURAL PRODUCTS SOLD ($):

135,115,200

VALUE OF FARM CAPITAL ($):

787,096,300

| HIRED LABOUR: | WEEKS | FARMS REPORTING |
|---|---|---|
| YEAR ROUND | 35,825 | 302 |
| SEASONAL | 33,248 | 582 |
| TOTAL | 69,073 | 718 |

| OFF-FARM WORK: | DAYS | FARMS REPORTING |
|---|---|---|
| AGRICULTURAL WORK | 23,461 | 141 |
| NON-AGRI. WORK | 98,810 | 478 |
| TOTAL | 122,271 | 585 |

| TENURE: | ACRES | FARMS REPORTING |
|---|---|---|
| AREA OWNED | 106,098 | 1,214 |
| AREA RENTED | 104,506 | 564 |
| TOTAL | 210,604 | 1,391 |

(* - AREA UNDER CULTIVATION)
(x - FIGURES NOT AVAILABLE)

as it enters the watershed and gives an indication of its potential for catalyzing chemical weathering in the watershed.

Loadings From Forested Areas

Forested ecosystems have different water quality than agricultural ecosystems. However, because the forested components are a small portion of the whole watershed, their impact upon water quality is aggregated in this study into the rural component of this study and hence is not considered further.

## 2.8 Stream Bank Erosion

A study on suspended solids loading to the Great Lakes (PLUARG; T. Dickenson, personal communication) indicated that 5-25 percent of this loading could be related to stream bank erosion. A separate study (I. Lorant, pers. comm.) showed that the average annual erosion rate of the stream bank could be anywhere from 1 to 18 cm/year.

Both of these studies indicate that streambank erosion could contribute significantly to suspended solids levels in the Don River. The magnitude of the loading is, however, difficult to define.

Further assessments are required for this source in the future.

## 2.9 Construction Activities

Erosion during construction may be extreme if proper measures are not taken (J.J. Armstrong, 1980). Estimates of erosion rates go as high as 1,000 times the normal levels for developed urban areas. The potential impact may also be shown by reviewing the findings from the Dry Weather Outfall Study (Canviro, 1986). The findings showed that 44 percent of the suspended solids loadings resulted from one outfall in which construction practices were noted.

## 2.10 Urbanization of the Upper Watershed

In their report on the planning and designing of urban BMP's (best management practices), the Metropolitan Washington Council of Governments (MWCOG, 1987)

## TABLE 2.14: ATMOSPHERIC CONCENTRATIONS, RAINFALL CONCENTRATION AND LOADINGS OF VARIOUS SUBSTANCES TO TORONTO AREA WATERSHEDS

|  | Rainfall Concentration (mg/L) | ATMOSPHERIC LOADING mg.m$^{-2}$.yr |  |
|---|---|---|---|
|  |  | Wet Dep. | Dry Dep. |
| Suspended Solids | N50 ug/m$^3$ air* | - | - |
| Total Phosphorus | 0.020-0.025 | 15 | - |
| Fecal Coliforms |  | - | - |
| TKN | 0.6-0.7 | 0.5 | - |
| Ammonia | 0.55-0.6 | 0.4-0.5 | - |
| Nitrate | 0.5-0.6 | 0.4-0.5 | 0.3-0.4 |
| Lead | 7 ug/L | 6 | 4-6 |
| Copper | 2 ug/L | 1.5 | - |
| Zinc | 8-9 ug/L | 6-7 | - |
| Atrazine | - | - | - |
| Methylochlor | - | - | - |
| Reactive Phenolics | - | - | - |
| PCB's** | (5-10 ng/m$^3$ air)<br>50 ng/L rain | total flux = 100-700 ng/m$^2$/y |  |
| Lindane | - | - | - |

*Env. Canada National Air Pollution Surveillance Data.

**Eisenreich, S.J., B.B. Looney and J.D. Thornton. 1981. Airborne organic contaminants in the Great Lakes ecosystem. Env. Sci. Technol. 15:30-39.

catalogued the effects of urbanization on a basin and the effect upon the local receiving waters. Pertinent material are now summarized.

During the urbanization process, the watershed in general becomes less able to retain water from precipitation. Trees and the humus layer which intercepted water and retained it in the storage are removed. Small depressions which might have ponded during precipitation events are graded to facilitate building. In addition, streets, parking lots, driveways and roofs shed virtually all of the incident precipitation. These changes in the morphology of the basin result in:

- two to five times increase in peak runoff rates,
- 50% more runoff volume for each storm,
- decreased time of concentration,
- increased flooding,
- reduced dry weather flows due to the reduced holding capacity of the basin, and
- higher stream channel velocities, contributing to higher erosion.

Civil engineering structures (concrete lined channels; piping of tributary streams) enhance these effects (Steedman, 1986).

These hydrologic changes result in a considerable increase in the erosion of both the stream bed and sloping lands in the basin. The erosion and redeposition of the material may result in stream channel changes.

Aquatic systems in the local streams may be considered to be adapted to the hydrologic and quality conditions which existed prior to the onset of development. After development, the increase in total flow volume, the change in hydrograph shape, and the increase in sediment load due to increased erosion, can reduce the habitat value of the stream. Stream substrate may be buried, removing spawning and feeding grounds from the local fish community. The ambient aquatic insect population may be swept away during high flow events or may be buried on the sedimentation regions of the slower moving reaches of the stream.

Erosion during construction in the basin can be particularly high from the areas actually under construction. Sediment loads of up to 45 tons per acre per year have been reported. As the urbanization ages, the area becomes more impervious as greater areas are developed and infill developments are initiated. Sediments generated from the urbanized area are not then due to construction but rather to the washing of the impervious areas during rainfall events. Between precipitation events atmospheric fallout of particulate matter, pet droppings, vegetative matter, litter and debris accumulate on impervious surfaces. Rainfall removes this material and carries it to the sewers and hence to the receiving stream.

In the receiving stream, sediment derived from the washoff of materials from the impervious area and erosion due to increased flow rates causes increased turbidity, reduced light penetration, clogging of fish gills and reduced spawning success. These factors have a direct effect upon the viability of aquatic species and may result in the disappearance of sensitive species.

Nutrients may be associated with the sediment from erosional processes or as soluble nutrients from fertilizer applications on lawns. In receiving streams or lakes, excessive nutrient loadings may result in increased algal blooms. These are often unsightly and, in the extreme, lead to water discolouring, mats of floating material, odours and oxygen depletion as the algal bloom decays. This increased rate of eutrophication is generally considered to be undesirable in receiving waters.

Fecal coliforms are used as an indicator organism to identify potential health risks due to immersion in the receiving waters. Accordingly, their concentrations in local runoff is frequently measured to identify the potential effects upon beaches or other recreational water uses. Bacteria in the storm waters usually reach concentrations well in excess of local water quality guidelines. In fact, concentrations of 40,000 organisms per 100 ml in runoff waters are not uncommon. Although bacteria will eventually die when they are outside their human host, sufficient numbers frequently persist for long enough to increase concentrations above acceptable limits at local beaches.

Oxygen demanding substances originate in urban runoff containing fecal matter, leaf litter and organic debris. Concentrations can reach 20 mg/L as BOD in storm water. In addition, in older areas where there may be combined sewers, periodic overflows add large amounts of oxygen demanding substances. In newer areas with greater sewer separation, lower amounts of oxygen demanding materials are exported. As organic materials decay in streams they consume the dissolved oxygen resources of the stream in competition with the local aquatic species. If too much organic material is discharged, the demand for oxygen may result in reduced dissolved oxygen concentrations and stress upon the aquatic species in the receiver.

A larger impact upon the receiving water may result from chloride washoff. In winter, salt applied to roadways for de-icing is washed off the roads, into the storm sewers as the snow melts or is released from snow dumps with the spring melt. Concentrations in the runoff may reach the same order of magnitude as that of sea water. Organisms typically have a limited range of tolerance to chloride concentrations and are susceptible to high shock concentrations which may occur during spring runoff.

## 2.11 Synthesis of Data for Urban and Rural Runoff

A summary of the rural and urban runoff data presented in this section, is given in Table 2.15 for wet conditions, and in Table 2.16 for baseflow conditions. For the event oriented conditions, the NURP data base is event oriented, while the riverine data bases (EMP for Grand River/Ausable River and Don River; PWQMN data base for rural area) include highflows and low flows.

The riverine data were used to assist the Habitat Suitability Index study (see Supporting Document 2).

TABLE 2.15: SYNTHESIS OF AGRICULTURAL AND URBAN DATA (FOR EVENTS)
(Units: mg/L unless otherwise noted)

| Parameter | AGRICULTURAL DATA<br>EMP Grand R.* | Little Rouge @ Steeles* | Other[1] | URBAN DATA<br>NURP Stormwater | EMP (Don R.)*[1] | Other |
|---|---|---|---|---|---|---|
| Suspended solids | 46 | 7 | 50,100 | 101 | 21 | - |
| Total phosphorus | .122 | .060 | - | .38 | .34 | - |
| Total kjeldahl nitrogen | - | 0.55 | | 1.5 | - | |
| Nitrate | 2.8 | 0.4 | | .68 | 2.3 | |
| Fecal coliforms | - | 1,000 | | | - | 20,000 |
| Copper | .006 | .004 | | .033 | .011 | |
| Lead | .003 | .003 | | .144 | .01 | |
| Zinc | - | .004 | | .135 | - | |
| Aluminum | - | | | | - | |
| Mercury (ug/L) | .03 | | | | .04 | |
| Oil and grease (ug/L) | - | | LT 1 | - | - | |
| Total PCP (Ng/L) | 6 | | | | 11 | |
| Total 2,4,5-T (Ng/L) | 100 | | | | LT 50 | |
| Atrazine | - | - | 0.9+ | - | - | LT 0.02+ |
| $BOD_5$ | - | 1 | | 10 | - | 20 |
| Dissolved oxygen | - | | 8** | | - | 7 |
| Chloride | - | | 32** | | - | |
| Temperature | - | | 22** | | - | 12 |

*75th percentile from box plots used for Little Rouge @ Steeles. 84th percentile from probability distribution of EMP probability plot used as indicator of event based wet weather water quality.

**Median value used since parameter is not flow sensitive.

+Mean spring value during runoff (Source: Nissouri Monitoring Project).

[1] Values used in Supporting Document 2.

TABLE 2.16: SYNTHESIS OF AGRICULTURAL AND URBAN DATA FOR BASE FLOW CONDITIONS
(Units mg/L unless otherwise noted)

| | AGRICULTURAL DATA | | | URBAN DATA | | |
|---|---|---|---|---|---|---|
| Parameter | EMP (Little Ausable)* | Little Rouge @ Steeles* | Other[1] | Thistledown (Humber R.) | EMP[1] (Don R.)* | Other |
| Suspended Solids | 24 | 5 | - | 5 | 8 | - |
| Total Phosphorus | .049 | .01 | - | .09 | .176 | - |
| Total Kjeldahl | - | 0.45 | - | 0.9 | - | - |
| Nitrate | 2.6 | 0.3 | - | - | 0.95 | - |
| Fecal Coliforms (#/100 ml) | - | 120 | - | 33,000 | - | - |
| Copper | .003 | .001 | - | .02 | .007 | - |
| Lead | .003 | .003 | - | LT.04 | .003 | - |
| Zinc | - | .003 | - | .04 | - | |
| Aluminum | - | - | - | - | - | - |
| Mercury (ug/L) | .01 | - | - | - | .02 | - |
| Oil & Grease (ng/L)_ | - | - | - | - | - | - |
| Total PCP (ng/L) | 2 | - | - | - | 5 | - |
| Total 2,4,5-T (ng/L) | LT20 | - | - | - | LT50 | - |
| Atrazine (ug/L) | - | - | 18++ | - | - | LT.02++ |
| Dissolved Oxygen | - | | 8** | - | - | 7 |
| Chloride | - | | 32** | - | - | - |
| Temperature (°C) | - | | 22** | - | - | 12 |
| Phenolics | - | | - | LT1.5 | - | - |

*25th percentile from box plots used for Little Rouge @ Steeles; 16th percentile from probability distribution of EMP used as indicator of low flow water quality.

**Median value used since parameter is not flow/suspended solids sensitive.

++Mean summer value from Nissouri Monitoring Project.

[1] Values used in aid of Supporting Document 2.

# 3.0 PROBLEM IDENTIFICATION

## 3.1 Study Reaches

### 3.1.1 Reaches Used in Previous Studies

Three sub-areas have been identified as having significantly different water quality problems (Cumming Cockburn, 1987) which require separate evaluation. They are:

| | |
|---|---|
| Subarea 1 | North of Steeles Avenue |
| Subarea 2 | South of Steeles Avenue: North of Massey Creek |
| Subarea 3 | South of Massey Creek to Lake Ontario (including the lower Don River, Keating Channel and the inner harbour). |

Subarea 1 is partially developed or is under active development. Both subareas 2 and 3 are fully developed urban areas.

Within each of these subareas specific tributaries of the Don River differ from the general condition of the subarea. These include Wilkett Creek which has elevated levels of methoxychlor and pp'-DDE; Massey creek which flows through the City of Scarborough and has a number of CSO's, industry and abandoned landfill sites and has elevated pesticide levels such as lindane; and German Mills Creek which has industrial landuse sources (Saplamaeff, 1987).

The following reaches have been identified, in the fisheries assessment (see Section 3.2.2 below) based upon habitat and fish species present:

- Lower River - Bloor Street/Pottery Road to Keating Channel (Section 3.2.3),
- Middle River - Langstaff Road to Bloor Street (Section 3.2.4),
- Upper River - Above Langstaff Road, (Section 3.2.5), and
- Tributaries - Massey Creek, Wilkett Creek, German Mills Creek (Section 3.2.6).

For an assessment of dry weather loading, the Don River system (Canviro, 1986) was broken up into many sections.

### 3.1.2 Reaches Assessed in This Study

For this study, the following reaches are assessed as indicated in Figure 1.

| Area of Don | Reach |
|---|---|
| West Don | 1. West Don Above Langstaff Road |
| | 2. West Don to Confluence with Wilkett Creek |
| | 3. Wilkett Creek |
| | 4. West Don from Wilkett Creek to Main Don Confluence |
| East Don | 5. East Don Above Langstaff Road |
| | 6. Little Don Above Germain Mills Creek |
| | 7. German Mills Creek |
| | 8. Lower East Don, German Mills to Confluence |
| Lower Don | 9. Massey Creek |
| | 10. Lower Don from confluence to STP |
| | 11. Lower Don from STP to Keating Channel |

The Keating Channel and Inner Harbour are not considered directly in this study. They are considered indirectly by the study objective of achieving water quality objectives at the upper end of Keating Channel and the role they play in influencing fish migration from the lake to the river.

### 3.1.3 Priority Reaches

With the number of water quality parameters to be considered (8-12) and the number of reaches, this would result in over 100 estimates of water quality concentrations (8-12 parameters at 11 reaches). It is difficult to assimilate this large number of estimates into the overall water quality improvement strategy which includes cost-effectiveness, methods of implementation and development of scenarios of different control options. A priority for parameters in particular reaches was developed.

This involved using six parameters:

- i) suspended solids;
- ii) total phosphorus;
- iii) ammonia;
- iv) copper;
- v) lead; and
- vi) fecal coliforms.

for four specific stream loadtions:

- i) West Don at Langstaff (Upper Reach);
- ii) West Don at confluence with Main Don (Middle Reach);
- iii) Massey Creek (a tributary) ; and
- iv) Lower Don at Keating Channel (Lower Reach).

## 3.2 Fisheries Objectives for the Don River

This section:

- o identifies features limiting the distribution and abundance of fish in the Don River;
- o divides the watershed into relatively homogeneous reaches; and
- o develops fisheries objectives for the watershed in general, and reaches in particular.

These fisheries objectives are then used within the framework of the Don River Water Quality Improvement Strategy in the development of water quality and hydrologic objectives for the Don.

### 3.2.1 Background

The Don River is highly urbanized, and fisheries resources have been adversely affected by barriers, turbid waters, and siltation for well over a century. The lower watershed has been urbanized for the longest period. The upper watershed in the Town of Richmond

Hill and the Town of Vaughan is strongly influenced by rapidly increasing urbanization (this area contains one of the fastest growing populations in the country) and by agriculture.

Based on D. Martin-Down's recent research and report on the Don River fishery, few of the species historically present in the river remain today. The dominant species are white sucker, blacknose dace, longnose dace and creek chub (dubbed as the "big four"). Carp enter the lower river from Lake Ontario seasonally for spawning, and other lake species such as emerald shiners also stray into the Keating Channel area. The upper river (generally north of Highway 7) is still dominated by the "big four", but a few other species are also present, including redside dace, a minnow recognized as sensitive to the effects of urbanization. A population of largemouth bass survives in the Richmond Hill Mill pond, and rock bass occur in the G. Lord Ross Reservoir on the West Don. Sculpin, a species preferring cooler, high quality water and natural habitat conditions is found only in isolated headwater areas where these conditions are still found. Other species native to clean, cool southern Ontario streams, such as the brook trout, no longer occur in the Don River.

The Don River, particularly the lower river (south of Steeles Avenue), supports primarily small adult individuals of the "big four" species. It appears that this is due to the lack of physical habitat (e.g., pools, in-stream cover) for larger individuals. The lack of large fish habitat, in turn, is probably due to the extreme flushing flow conditions following storm events, resulting in scouring of the stream bed.

Fish communities in some of the smaller streams, most notably Massey Creek, Wilkett Creek, and German Mills Creek, appear to be affected by periodic toxic spills. These have included blockages of sewers and injection of chlorine to alleviate resultant problems. The watersheds of Massey and German Mills Creeks are highly industrialized, and suspicious slugs of discoloured water have been observed during fish collection programs. Some of these areas appear to be devoid of fish life, despite apparently suitable habitat conditions for members of the "big four".

### 3.2.2 Watershed Reaches for Fisheries Objectives

The Don River watershed may be divided into several sections, based on watershed and fisheries characteristics:

- Lower River - Bloor Street to Keating Channel
  - Keating Channel
  - Downtown Core
- Middle River - Langstaff Road to Bloor Street
- Upper River - North of Langstaff Road
- Tributaries - Massey Creek, Wilkett Creek, German Mills Creek

### 3.2.3 Characteristics of the Lower River

The Keating Channel affords little true riverine habitat, and in some respects is like an extention of the inner harbour. The physical configuration of the channel may make the Don River unrecognizable as a river to various species. The channel is relatively uniform and there is no riparian riverbank cover. Sediments in the channel are heavily contaminated with oily residues. With its present configuration, the channel should not be expected to support a population of riverine fishes.

An appropriate fisheries objective for Keating Channel would be to provide a more stabilized flow regime and a reduction in contamination from CSOs and other sewers so that fish can move more readily between the lake and the river. For purposes of this study, the Keating Channel was determined to be outside the study scope and hence, is not included herein.

Upstream of the Keating Channel, the Don River passes through a parkland belt in the city core. White suckers migrate from the lake through this section in spring and successfully spawn in the riffle habitat found near Bloor Street. Carp also migrate through this section for spawning, although no evidence for successful reproduction has been found.

The minimum fisheries objective for this section is the maintenance of the status quo. Achievement of this objective would probably require that no further increases in stream flow variation occur, and that existing riparian vegetation in the park belt be maintained. It would probably also require that loadings of contaminants that are causing apparent toxic effects in upstream tributaries, particularly Wilkett Creek and Massey Creek, not be permitted to increase.

A habitat suitability index (HSI) model was developed for creek chub by the U.S. Fish and Wildlife Services. This is one of the four species which could be used as a target species for habitat management purposes. Habitat requirements for maintenance of the fish community status quo should be identified using the creek chub HSI, so that the sensitivity of the lower Don fish community to changing habitat quality (streamflow, water quality) can be evaluated. The HSI identifies physical-chemical habitat features that can be predictively modelled, so that HSI sensitivity to changing streamflow-water quality can be determined. A predicted drop in HSI for any watershed-development/control scenario would be incompatible with the minimum fisheries objective.

An achievable fisheries objective for this section would be the establishment of a piscivore fish population which is an indicator of a restored balanced ecosystem. Largemouth bass appear to be relatively tolerant of organic pollution. The limiting factors for this species in the lower Don are probably the extreme variation in flows and the lack of instream cover (pools, undercut banks, brush piles, large rocks, aquatic vegetation, etc.). This species could probably be re-established through the implementation of measures to reduce peak flows and increase minimum flows, as well as to create appropriate instream habitat features in the river. The HSI should be examined to define the required flow regimes for largemouth bass.

It may also be appropriate to consider the suitability of the lower Don River for seasonal use by migrating salmonid species from Lake Ontario, such as the Brown Trout and Chinnok Salmon, as a water quality and river habitat criteria. This would provide further enhancement to the recreational fishery and the aesthetic value of the river. These species currently migrate into all tributaries of Lake Ontario where habitat conditions permit.

### 3.2.4 Characteristics of the Middle River

The characteristics of the Don River fish community here are similar to those in the lower river (south of Bloor Street). Throughout most of this section, the Don River consists of two major branches - the West Don and the East Don. It was felt that the same fisheries objectives identified for the lower river should apply to this stretch. It was noted that the G. Lord Ross Reservoir on the West Don near Dufferin Avenue and Finch Avenue should be evaluated in terms of its present operation and means of optimizing its operation for controlling downstream flow and water quality identified, thereby helping to achieve downstream habitat conditions to meet fisheries objectives.

### 3.2.5 Characteristics of the Upper River

The upper Don River watershed is becoming rapidly urbanized. Many of the smaller streams (first and second order) are being channelized, and gently sloping floodplain areas filled in for residential, commercial and industrial development. Many of the non-developed stream valley areas are agricultural, with relatively little riparian vegetation. These streams are important in the maintenance of natural fish species and communities which continually augment or sustain fish populations in lower reaches of the river. As well, these smaller tributaries serve to regulate river flows and water quality conditions further downstream. Because of intense development pressure, as well as the higher diversity of fish in the community of the upper watershed, maintenance of the status quo will be more difficult. Development plans often approved several years ago are including activities such as channelizing or piping of small streams. In many cases, developers are filling in floodplain areas of the small order of 1 to 3 streams for construction. This strong development pressure, extremely high land values in the area, and the in-grained development practices and approvals procedures that permit the destruction of stream valleys are causing increasing losses of fish species from individual stretches and tributaries. Implementation of the Plan in this area will be the most challenging of all areas.

Maintenance of the status quo should be based on the habitat requirements of the most sensitive species recognized in this area - the redside dace. A threatened status has been proposed for this species to the Committee on the Status of Endangered Wildlife in Canada. In all of Canada, the redside dace is known only from the Golden Horseshoe area. This species requires extensive riparian vegetation and relatively low turbidity. It is probable that the status quo can only be maintained in the upper river through elimination of channelization practices, the maintenance of buffer strips along streambeds, control of massive sediment loadings from construction areas, and the maintenance of current hydraulic regimes. The redside dace should be considered in the management plan, but final decisions have not been made as to its use.

### 3.2.6 Characteristics of the Tributaries: Massey Creek, Wilkett Creek and German Mills Creek

These small streams have all been found to have stretches that are devoid of fish life, and are apparently affected by toxic discharges of unknown substances. The status quo option is considered unacceptable for these streams. Re-establishment of conditions suitable for some of the more tolerant endemic fish species occuring in other sections of the Don River is identified as the desirable option.

The HSI approach, as it is not based on chemical toxicants, is inadequate in defining habitat requirements for this section. Meeting all PWQO's for individual chemicals (metals, etc.) most of the time, and elimination of toxic events, will probably permit the achievement of this objective since other habitat requirements appear adequate. This may be through source control, if possible, or capture and treatment of stormwaters released between peak flow periods (when dilution may be adequate).

### 3.2.7 Fisheries Objectives for the Don River

Based upon these characteristics and targets, fishery objectives were established for each section of the Don River and are given in Tables 2.2.1 to 2.2.4. The section headings of each table are:

1. Section Boundaries
2. Fisheries Objective for Section
3. Limiting Factors to Existing Fishery
4. Collected Species
5. Target Species
6. Current Water Quality Impacts Upon Fisheries

TABLE 3.2.2 TRIBUTARIES: GERMAN MILLS, WILKETT CREEK, MASSEY CREEK

2.1 **Section Boundaries**

The individual creek; generally in the middle/upper reaches of the Don.

2.2 **Fisheries Objective**

1) improvement in streams (creek chub indicator)
2) mitigate water quality impacts to main river

2.3 **Limiting Factors**

- chemical spills major problem
- habitat loss - channelization extensive
- barriers to fish migration
- high peak flows (note: base flows appear adequate for sustaining a fishery)

2.4 **Collected Species**

- White sucker
- Blacknose dace
- Longnose Dace
- Cheek chub

Goldfish
Pumpkin seeds

2.5 **Target Species**

- target species creek chub

2.6 **Current Water Quality Impacts**

- water quality and flow conditions major issues. This limits fish fauna even where suitable habitat remains. Some excellent habitat sections remain in park areas.
- the major effect on lack of fish may be spills of toxic substances such as ammonia.
- the possibility of ammonia avoidance needs further analysis since the unionized ammonia levels in monitoring data are below PWQO's.

2.7 **Management Requirements/Focus**

- spill control by ponds.
- water quality improvement - industrial sources.
- responses to above limiting factors.

2.8 **Broad Management Criteria for Tributary Streams**

- maintain or improve fisheries potential in middle and lower reaches.
- re-establish missing species.

TABLE 3.2.2 TRIBUTARIES: GERMAN MILLS, WILKETT CREEK, MASSEY CREEK

**2.9 Management Philosophy of Tributaries Within a Watershed Perspective**

1) Many fish species which should be present, are not. The habitat appears adequate, suggesting that barriers or water quality may be the major limiting factor.
2) Proposed target fish species are an indicator or good water quality and a balanced ecosystem.
3) While the scope for management is limited because of the small sizes of these creeks, the scope for management is large in terms of re-establishing a fishery resources, especially in stretches which are devoid of fish.

**2.10 Tools Available for Quantifying Impacts**

- IBI data of Steedman
- HSI for Creek Chub
- Toxic chemical concentrations by mass balance

**2.11 General Priorities for Tributaries**

1) Eliminate chemical spills and other toxic substances.
2) Modify barrier to allow fish passage or stock stream sections.
3) Reduce flashiness of peak flows.

TABLE 3.2.3: MIDDLE REACHES OF DON RIVER

---

**3.1 Section Boundaries**

- Langstaff Road to Bloor Street (west and east Don branches)

**3.2 Fisheries Objective**

1) Status quo minimum - creek chub
2) largemouth bass capability - ecosystem criteria

**3.3 Limiting Factors**

- excessive peak flows - effects on river channel and habitats - eroded channels.
- areas of good riparian vegetation and canopy - extensive park systems.
- poor instreams habitat - shallow flows, wide channel, no instream cover, poor stream morphologic development (riffles/pools).
- water quality problems - excessive silt loads, some toxic inputs (spills).
- some channelization.
- weir at Pottery Road a migration obstacle for lake migrant populations.

**3.4 Collected Species**

| | | |
|---|---|---|
| - White sucker | Blacknose dace | Johnny darter |
| - Goldfish | Longnose dace | |
| - Redbelly dace | Creek chub | |
| - Fathead minnow | Pumpkin seed | |

**3.5 Target Species**

- creek chub - status quo.
- largemouth bass
  - potential capability
  - represent ecosystem restoration
  - predator for "big four" resident species.
  - indicator of acceptable water quality/balanced fish community/food chains.

**3.6 Current Water Quality Impacts on Fishery**

- turbidity and silt loads.
- chemical spills.

**3.7 Management Requirements/Focus**

1) spill control
2) water quality improvement
3) habitat remediation to above limiting factors

**3.8 Broad Management Criteria for Middle Sections**

1) maintain status quo
2) make habitat and water quality improvements to:
   - improve fishery
   - act as an integrator of a more balanced ecosystem.

TABLE 3.2.3: MIDDLE REACHES OF DON RIVER

### 3.9 Management Philosophy of Middle Reaches Within a Watershed Perspective

1) It would be difficult to substantially alter the design of the urban areas and their impacts upon flow and turbidity (bank erosion).
2) There are opportunities for achieving significant impacts by:
   - improving riparian habitat.
   - controlling water quality excesses associated with spills and other types of extrema.

### 3.10 Tools Available for Quantifying Impacts

- IBI data of Steedman
- Fluvial - fish linkages established by Morris (Master's Thesis, Trent University)
- HSI for creek chub and largemouth bass.

### 3.11 General Priorities for Middle Reaches

1) Control peak flows and erosion potential.
2) Improve fishery access for migratory purposes.
3) Improve habitat.
4) Control spills.

## TABLE 3.2.4: LOWER REACHES OF DON RIVER

### 4.1 Section Boundaries

- Bloor Street to Keating Channel

### 4.2 Fisheries Objective

1) As in middle reaches.
2) Suitability for seasonal use by anadromous salmonids from Lake Ontario (brown trout, chinook salmon)

### 4.3 Limiting Factors

- water quality - stormwater (CSO) discharges to lower river, STP input, industrial spills.
- channeled lower section and estuary (harbour).
- major siltation of river habitats.
- riparian vegetation minor factor.
- channel morphology major limitation - substrates, lack of riffles/pools, shallow depths (wide scoured channel).
- no migration obstacles (physical).

### 4.4 Collected Species

- White sucker
- Emerald shiner (lake species)
- Spottailed shiner (lake species)
- Fathead
- Blacknose dace
- Longnose dace

Creek chub
Brooke stickleback
Pumpkin seed
Carp (migratory)

### 4.5 Target Species

- creek chub - status quo indicator.
- largemouth bass - ecosystem restoration (as for middle reaches).
- brown trout - representative for anadromous salmonids.
    - more tolerant species for temperature and turbidity.
    - for anadromous run only - not self-sustaining.
    - indicator for chinook salmon, coho, etc.

### 4.6 Current Water Quality Impact on Fishery

- turbidity some impact.
- temperature limits fishery to warm water species.
- perceived impact of CSO's, STP's, industrial discharge and spills; exact impact is not well quantified.

### 4.7 Management Objective/Focus

- achieve water quality conditions suitable for fish movement through river below Bloor - no habitat sector/functions justified below Bloor.

TABLE 3.2.4: LOWER REACHES OF DON RIVER

### 4.8 Broad Management Criteria for Lower Reaches

1) Maintain status quo.
2) Make modest improvements by:
   . improvement of habitat where practical.
   . improve water quality.

### 4.9 Management Philosophy of Lower River Within a Watershed Perspective

1) There is not much scope for management because:
   - much of the lower river is extensively channelized and protected by dikes/retaining walls.
   - fishing access is essentially non-existant.
   - the physical habitat does not provide much opportunity for hatching/rearing.
   - the major function of the lower river is as a passage way for:
     . upstream migration.
     . temporary living by species such as carp.
   - cost of extensive rehabilitation would be quite expensive and require many alterations to present uses of shore-line property.
2) There is, and probably will never be into the foreseeable future, an extensive recreational fishery.
3) The immediate approach should be to maintain the status quo and establish an improvement in the fishery which is an indicator of improvement in aesthetics.
4) For the long term (50 to 100 year planning horizon), a change in the urban/industrial design as old buildings are replaced by new buildings will allow for habitat improvements which may have a significant impact upon the fisheries of the Lower Don.

### 4.11 General Priorities For Lower Reaches

1) Improve water quality.
2) Establish target species which can be used as an indicator in the improvement of habitat conditions and aesthetics and monitor their response.
3) Improve fish habitat as urban design changes (over long term planning perspective).

TABLE 3.3.1: WATER QUALITY AND CONTROL VARIABLES

| Water Quality Parameter | Water Quality Objectives | | | Water Quality Characteristics | | | | | | | Enhanced Tributary Monitoring | | | Effects of Controls | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PWQO | CWQO | Other | Storm Water (NURP) | CSO (NURP) | Agri-culture | STP | Rouge Up-Stream | Little Rouge | St. Catha-rines | Humber | Don | Rural Source | Control Pond | Non-Struc. Urban BMP | Agri-culture BMP |
| Health of Ecosystem | | | | | | | | | | | | | | | | |
| o DO | | | | | | | | | | | | | | | | |
| Water Clarity | | | | | | | | | | | | | | | | |
| o Suspended Solids | | | | | | | | | | | | | | | | |
| o Turbidity | | | | | | | | | | | | | | | | |
| o Oil and Grease | | | | | | | | | | | | | | | | |
| o Colour (HA, FA) | | | | | | | | | | | | | | | | |
| Eutrophication (Nutrients) | | | | | | | | | | | | | | | | |
| o TP/SP | | | | | | | | | | | | | | | | |
| o TKN; $NH_3$; Org. N. | | | | | | | | | | | | | | | | |
| o $NO_3$, $NO_2$ | | | | | | | | | | | | | | | | |
| Human Health | | | | | | | | | | | | | | | | |
| o Nitrite, etc. | | | | | | | | | | | | | | | | |
| o Bacteria - Fecal Coliforms | | | | | | | | | | | | | | | | |
| - E. Coli | | | | | | | | | | | | | | | | |
| - P. Aeroginosa | | | | | | | | | | | | | | | | |
| - Klbesiella | | | | | | | | | | | | | | | | |
| o Trace Metals | | | | | | | | | | | | | | | | |
| - Cu, Cd, Cr, Zn, Ni Pb, Al | | | | | | | | | | | | | | | | |
| - Fe, Mn | | | | | | | | | | | | | | | | |
| - As, Hg, Se | | | | | | | | | | | | | | | | |
| o SOC's (Synthetic Organic Chemicals) | | | | | | | | | | | | | | | | |
| - pesticides | | | | | | | | | | | | | | | | |
| - herbicides | | | | | | | | | | | | | | | | |
| - solvents (phenol, toluene, benzene) | | | | | | | | | | | | | | | | |
| - PAH's | | | | | | | | | | | | | | | | |
| - PCB's | | | | | | | | | | | | | | | | |
| - mirex, dioxin | | | | | | | | | | | | | | | | |
| - others | | | | | | | | | | | | | | | | |
| o Toxicity Testing | | | | | | | | | | | | | | | | |
| Oxygen Demand | | | | | | | | | | | | | | | | |
| o BOD | | | | | | | | | | | | | | | | |
| o SOD | | | | | | | | | | | | | | | | |
| Heat | | | | | | | | | | | | | | | | |
| o Temp. | | | | | | | | | | | | | | | | |

7. Management Requirements/Focus
8. Broad Management Criteria
9. Management Philosophy for River Section Within Overall Watershed Perspective
10. Tools Available for Quantifying Impacts
11. General Priorities for River Section

### 3.2.8 General Recommendation for Further Work in Fisheries - Water Quality Area

A need for flood plain mapping, land use assessment and classification of stream bank and riparian vegetation condition was identified, in order to permit establishment of baseline conditions, and required buffer strips within the Plan. This recommendation arose from the meeting on settling fisheries objectives attended by various people from MOE, MNR, MTRCA, BEAK and Theil. It is made because the streams need to be classified as to their degree of cover and its influence on stream temperature and whether there is a likelihood of developing a fishery.

## 3.3 Water Quality Parameters

### 3.3.1 Water Quality Parameters of Potential Concern

A list of possible parameters to be considered in this study are given in Table 2.3.1. The parameters in Table 3.3.1 are grouped according to various bases for regulatory action including:

- Health of the ecosystem (fishery);
- Water clarity (aesthetic, fishery)
- Eutrophication;
- Human health;
- Oxygen demand (affecting DO); and
- Heat (Temperature, affecting fishery).

These parameters include the broad categories of concern listed in the RFP, namely bacteria, heavy metals, pesticides, industrial organics and conventional parameters. Aluded to, but not specifically included in the list, are chemicals such as gasoline and other products resulting from spills. A summary of the available data describing most of these parameters in the Don River has been summarized in Supporting Document 5. If all these water quality parameters were evaluated in this study, several deficiencies may result. These deficiencies would be due to the following:

- the concentration of many of these water quality parameters in urban runoff (CSO, storm sewers) are imprecisely known.
- the impact of control options upon reducing concentrations of many of these substances have not been measured.

Hence, this study could suffer from a credibility problem if all the substances listed in Table 3.3.1 were calculated.

Data available from the various studies on the Don River and other literature have been critiqued in other studies. The format of Table 3.3.1 was used in this study to provide an overview of the effects of different sources and of control upon water quality in the Don River system. Table 3.3.1 was used as the organ, rational concept, but was not completed in this study.

### 3.3.2 Water Quality Parameters for Fisheries Objectives and Other Uses

Habitat rehabilitation is one key to fishery enhancement. Water quality parameters which are limiting to the Habitat Suitability Index (HSI) include:

- turbidity,
- flow at critical times,
- depth of water at critical times (e.g., spawning during spring runoff, migration, in fall),
- temperature, and
- dissolved oxygen.

To assess the effects of flow and depth of water, Water Survey of Canada (WSC) data will be used. A method for the evaluation of dissolved oxygen and turbidity (suspended solids) is proposed below. Temperature can be assessed indirectly since habitat rehabilitation (a mitigating measure) by construction of a canopy etc. would have a larger impact on temperature than remedial measures such as control options (except for perhaps a wet, on line pond).

Other water quality variables which influence the fishery are mainly related to the health of the fishery. Fish avoidance of ammonia in certain tributaries requires assessment of ammonia concentrations. Metal and SOC (e.g., PCB, Methyl Hg) levels may need to be assessed to evaluate the edibility of the fishery and to reduce the stress on the fishery. Such analyses are complicated by the migratory nature of many fish species from the lake upstream.

Appropriate water quality parameters for other end-uses include the following:

- swimming - fecal coliforms,
- canoeing - water clarity (turbidity; presence/absence of oil slicks),
- human health - a selected trace metal
  - a selected SOC (e.g., an industrial chemical)
  - a selected pesticide
- drinking water - parameter to be selected if drinking water is obtained from the Don River.
- aesthetics - water clarity
  - presence/absence of odours and oil slicks/scums
  - frequency of spills

### 3.3.3 Synthesis of Water Quality Parameters

The following groups of parameters are considered in this study:

- major parameters,
- metals, and
- organics.

Other parameters which are not measured in routine programs include the impact of construction activities and spills. An attempt was made to address these qualitatively.

## 1. Major Parameters

| Parameter | Reach | Rationale for Selection |
|---|---|---|
| Flow | Main branches | o carrier solvent (fluid) |
| Suspended Solids | Main branch | o critical parameter for aesthetics and fisheries (turbidity)<br>o carrier material for many contaminants |
| Total Phosphorus | Main branches | o control eutrophication in many aquatic systems |
| Fecal Coliforms | Main branches | o Indicator organisms for body contact objectives |
| Colour | All branches | o indicator of aesthetics |
| Dissolved Oxygen | Selected Branches* | o Critical parameter for fish |
| BOD | Selected Branches* | o Parameter influencing DO |
| TKN | Selected Branches* | o Parameter influencing DO |
| Ammonia | Tributaries | o Parameter potentially toxic to fish |
| Chloride | Main Branches | o Conservative parameter as a tracer of water movement |

*Selected branches: 1 tributary, one main stem section are suggested.

## 2. Metals

| Parameter | Reach | Rationale for Selection |
|---|---|---|
| Copper | Main branches | o PWQO exceedance |
| Zinc | Main branches | o PWQO exceedance |
| Lead | Main branches | o PWQO exceedance |

## 3. Herbicides, Pesticides, and Industrial Organics

The following compounds are considered. Because many of the demonstrated problems are reach-specific, few compounds have been evaluated on a watershed basis.

| Parameter | Reach | Rationale for Selection |
|---|---|---|
| Atrazine | Main branches of East, West, Lower Don | o Herbicide used in agricultural (corn) systems.<br>o Has short decay times; is transported by soil leaching and erosion.<br>o Will be a sensitive variable for looking at impacts of development of upper watershed.<br>o Assume no contributions from urban areas. |
| Methoxychlor | Wilket Creek<br>Lower West Branch<br>Lower Don | o Exceedances observed in these branches<br>o Have few data on dry weather/event data.<br>o Search MISA data for WWTP effluent. |
| Lindane | Massey Creek<br>Lower West Branch | o Of particular interest to MOE.<br>o Sources can be explained.<br>o Have few data for STP or for dry weather/wet stormwater. |
| Lindane | Lower West Branch | o Search MISA data for WWTP effluent characteristics and apply generically to North Toronto plant. |
| Reactive Phenolics | Lower West Branch<br>Lower Don | o Exceed PWQO's at Lakeshore site for entire period of 1964-1984. |
| PCP | ? | o Had significant number of |

| | | |
|---|---|---|
| | | exceedances.<br>o Not included in reactive phenolics test.<br>o Will completely follow suspended solids.<br>o Source data is lacking; may need to be dropped. |

## 4. Episodic Based Phenomena

| | | |
|---|---|---|
| Spills | Main Stream | o Affect aesthetics and aquatic life. |
| Construction Impacts | Upper Reaches | o May exceed suspended solids from erosive activities.<br>o Assess using literature |

### 3.3.4 Method of Evaluating Riverine Concentrations

The approach considered for evaluating riverine concentrations and loadings from the Don River are given below. The basic philosophy of the original proposal (mass balance divided by flow) is retained except for a few parameters.

| Parameter | Calculation Approach/Philosophy |
|---|---|
| Flow | o WSC gauge; regression approach for low flow plus generic SWMM to relate size of rainfall to runoff for storm sewers.<br>o Flow balance is forced. |
| SS | o Mass balance plus estimates from bank erosion and construction activity. |
| TP | o Mass balance. |
| FC | o Mass balance plus 1st order decay. |
| Colour | o Mass balance. |

| | | |
|---|---|---|
| DO, BOD, Temp. | o | QUAL2E generic run. |
| Metals | o | Mass balance |
| Organics | o | Mass balance |
| Construction SS | o | Estimate from literature. Also assess changes in construction practice (e.g., early vegetation of laws, etc.) |
| Spills | o | Estimate size and frequency |

### 3.3.5 Short List of Parameters

A short list of these parameters are selected for quantiatively assessing the effectivenss of water quality control.

They are:

- total phosphorus,
- suspended solids,
- fecal coliforms,
- copper,
- lead, and
- ammonia

The selection is based in part upon the following assessment. Data available for estimating loadings are good for major parameters and metals but poor for synthetic organic chemicals, and negligible for colour.

These parameters integrate changes in these water quality variables with the level of protection and such factors as:

- cost effectiveness,
- frequency of PWQO violation,
- implementability, and
- conflict potential.

These parameters provide a general indication of water quality while being quantifiable using a simple mass balance approach. Other parameters are considered qualitatively.

## 4.0 OTHER CONSIDERATIONS FOR DEVELOPING OBJECTIVES OF THE WATER QUALITY MANAGEMENT STRATEGY

### 4.1 Stakeholders Concerns

The stakeholders concerns were summarized in a previous report (Cumming Cockburn, 1987). As noted in this report the comments received from the stakeholders ranged from deeply concerned about water quality issues to a lack of interest in participating in any sort of water quality management plan for the Don River. The opinion of the various agencies depended strongly on the location within the watershed, the present and fugure usage of the river and the particular mandate of the resource management agency.

The comments from the stakeholders should not be taken as being completely representative of the agency involved. Generally, only one individual from each agency was interviewed. Furthermore, the interviews were conducted at staff level and may not represent the stakeholders concerns as a corporate/institutional entity.

As part of this study, further discussions have been held with MNR, specifically with respect to fisheries concerns and objectives.

### 4.2 Public Consultation

Public consultation, to date, has not been included as part of the study. At this time it is felt that this process be carried out as a separate task by MOE staff.

### 4.3 Rationale for Provincial Water Quality Objectives

In this section the rationale for PWQO's and/or Canadian Water Quality Guideline (CWQG) are presented for each parameter selected for consideration in this study. The appropriate standards are compared in Table 1. Various PWQO values reported are undergoing active review and continuous revision with updating due in the near future.

## TABLE 1 WATER QUALITY CRITERIA FOR THE PROTECTION OF AQUATIC LIFE

| Parameter | PWQO[5] | CWQG[6,7] (old) | CWQG[8] (new) | EPA[9,10] |
|---|---|---|---|---|
| Suspended Solids | Suspended matter should not be added to surface water in concentrations that will change the natural Secchi disc reading by more than 10% | Natural season maximum | Increase of 10 mg/L when background is less or equal to 100 mg/L, or increase of 10% above background when background is greater than 100 mg/L | Reduction of more than 10% of depth of compensation point for photosynthetic activity |
| Phosphorus (total) | 10 to 30 ug/L[1] | 25 to 100 ug/L[1] | - | 25 to 100 ug/L[1] |
| Ammonia | 20 ug/L as un-ionized form | 20 ug/L as un-ionized form | 80 to 2,500 ug/L as total ammonia depending on pH and temperature (equals 0.7 to 35 ug/L un-ionized; e.g., 25 ug/L at pH 8 and 10°C) | 0.7 to 370 ug/L (un-ionized) depending on pH, temperature, species sensitivity and is based on 1-hour and 4-day averages (e.g., max. 4-day average at pH 8 and 10°C for salmonids is 25 ug/L) |
| Nitrite | 1 mg/L[2] | 1 mg/L[2] | 0.06 mg/L | |
| Nitrate | 10 mg/L[2] | - | Concentrations which cause excessive weed growth | 10 mg/L[2] |
| Nitrite + Nitrate | 10 mg/L[2] | 10 mg/L[2] | - | - |
| Fecal Coliforms | Geometric mean density of 100 per 100 mL for a series of water samples[2] | Geometric mean density of at least 5 samples over a 30-day period should be less than 200 per 100 mL[2] | Geometric mean density of at least 5 samples over a 30-day period should be less than 200 per 100 mL[2] | Geometric mean density of at least 5 samples over a 30-day period should be less than 126 per 100 mL for E. coli and 33 per 100 mL for enterococci |
| Copper | 5 ug/L (unfiltered) | 2 ug/L | 6 ug/L[3] | 21 ug/L[3] as 4-day average<br>34 ug/L[3] as 1-hour average |
| Lead | 25 ug/L[3] (unfiltered) | 10 ug/L[3] | 7 ug/L[3] | 7.7 ug/L[3] as 4-day average<br>200 ug/L[3] as 1-hour average |
| Zinc | 30ug/L (unfiltered) | 200 ug/L[3] | 30 ug/L | 190 ug/L[3] as 4-day average<br>210 ug/L[3] as 1-hour average |
| Aluminum | - | 100 ug/L[4] | 5 ug/L (pH L 6.5)<br>100 ug/L (pH GE 6.5) | 150 ug/L (pH between 6.5 and 9.0) as 4-day average<br>950 ug/L (pH between 6.5 and 9.0) as 1-hour average |
| Mercury | 0.2 ug/L (filtered) | 0.1 ug/L (unfiltered) | 0.1 ug/L | 0.012 ug/L as 4-day average<br>2.4 ug/L as 1-hour average |
| Oil and Grease | Should be visually and olfactorily non-detectable | 5 mg/L[1] | Should be visually and olfactorily non-detectable | Individual petrochemicals should not exceed 0.01 of 96-hour LC50 of important sensitive species. Surface waters should be virtually free of oils |
| Pentachlorophenol | 0.5 ug/L[12] | None | 0.5 ug/L | 15.6 ug/L[13] as 4-day average<br>24.8 ug/L[13] as 1-hour average |
| 2,4,5-T | None | None | None | None |
| Atrazine | None | None | None | None |
| $BOD_5$ | None - see dissolved oxygen | | | |
| Dissolved Oxygen | 47 to 63% of saturation must be maintained dependent on resident biota | 47 to 63% of saturation must be maintained dependent on resident biota | 5 to 9.5 mg/L dependent on resident biota and life-stage | 3 to 9.5 mg/L dependent on resident biota and life-stage |
| Chlorine | 2 ug/L | 2 ug/L | 2 ug/L | 11 ug/L as 4-day average<br>19 ug/L as 1-hour average |
| Chloride | None | None | None | None |

---

[1] No objective for protection of aquatic life  Guidelines based on nuisance algal growth, aesthetic deterioration and/or excessive plant growth.

[2] No objective for protection of aquatic life. Maximum acceptable concentration related to human health.

[3] Based on a hardness of 200 mg/L ($CaCO_3$). Criterion is dependent on hardness.

[4] Tentative limit proposed by IJC (1977).

[5] Provincial Water Quality Objectives; MOE (1984)

[6] Canadian Water Quality Guidelines; Environment Canada (1981).

[7] McNeely et al. (1979).

[8] CCREM (1987).

[9] U.S. EPA Water Quality Criteria; U.S. EPA (1976).

[10] U.S. EPA (1986); most objectives allow for one exceedence every three years.

[11] Draft Objective, proposed 1986.

[12] Proposed, McKee et al. (1984).

[13] Based on pH of 8. Criterion is dependent on pH.

TABLE I (cont'd.) WATER QUALITY CRITERIA FOR THE PROTECTION OF AQUATIC LIFE

| Parameter | PWQO[5] | CWQG[6,7] (old) | CWQG[8] (new) | EPA[9,10] |
|---|---|---|---|---|
| Total Phenols | 1 ug/L | 1 ug/L | 1 ug/L | contaminant-specific limits |
| Lindane (g-BHC) | 0.01 ug/L | 0.01 ug/L | 0.01 ug/L | 0.080 ug/L[15] as 24-h max. and 2.0 ug/L as instantaneous max. |
| Methoxychlor | 0.04 ug/L | none | 0.03 ug/L | 0.03 ug/L |

---

[14] Based on organoleptic data
[15] Federal Register 1980

### 4.3.1 Suspended Solids

Turbidity is a measure of suspended particles such as silt, clay, organic matter, plankton and microscopic organisms in water. While relatively non-toxic to aquatic organisms, high turbidity reduces photosynthesis of submerged, rooted aquatic vegetation and algae and may, in turn, suppress fish productivity (MOE, 1979; CCREM, 1987). Therefore, the optical property of suspended solids has been used to establish water quality guidelines and criteria. Since the degree of turbidity varies naturally between surface waters, provincial and federal guidelines limit the variation in suspended solids to 10% from a seasonally adjusted norm for any given water body. For waters that average less than 100 mg/L suspended solids, Canadian guidelines (CCREM, 1987) allow up to 10 mg/L variation, since good to moderate fisheries can be maintained at concentrations of less than approximately 100 mg/L.

### 4.3.2 Total Phosphorus

Phosphorus is a nutrient actively taken up by plants in surface waters and is not, therefore, found in significant concentrations, except in waters receiving organic inputs. It is a non-metallic element which occurs as dissolved and particulate, organic and inorganic forms. Phosphorus in chemically combined form (the elemental form is rare) is virtually non-toxic to aquatic life (MOE, 1979). Its concentrations need to be controlled, however, to prevent excessive algal and macrophyte growth which may increase turbidity, lower oxygen near the bottom due to decomposition, change the aquatic species composition and/or be aesthetically undesirable (MOE, 1979; CCREM, 1987). Three levels of quality have been established by the MOE (1984). To avoid nuisance algal growth in lakes, the average phosphorus concentration for the ice-free period should not exceed 20 ug/L. A high level of aesthetic deterioration in lakes is provided by a total phosphorus concentration of 10 ug/L or less during the ice-free period. Excessive plant growth in rivers and streams should be eliminated at total phosphorus concentrations of 30 ug/L or less.

### 4.3.3 Ammonia Nitrogen

Ammonia is input directly into surface waters from such sources as municipal and industrial effluents, agricultural runoff and in atmospheric precipitation. It is also input indirectly via chemical and biochemical transformation of nitrogenous matter in soil and water, nitrogen fixation of dissolved nitrogen in water, and excretion of ammonia by biota (McNeely et al., 1979; MOE, 1979). Aquatic ammonia is in constant equilibrium with its ionized ammonium form, a relationship which is highly temperature- and pH-dependent. Un-ionized ammonia is the form most toxic to aquatic biota (MOE, 1979; CCREM, 1987). The water quality objectives for Ontario (MOE, 1984) and Canada (CCREM, 1987) are thus based on un-ionized, rather than total, ammonia, and incorporate temperature and pH effects. The current Canadian guidelines are reported as total ammonia, however, so that calculation of the un-ionized fraction is unnecessary.

### 4.3.4 Kjeldahl Nitrogen

Total Kjeldahl nitrogen is a measure of ammonia plus organic nitrogen. Organic nitrogen per se is not of concern to human health, so no guidelines for drinking water or for the protection of aquatic life have been proposed (McNeely et al., 1979). Its role is mainly related to the supply of ammonia resulting from the hydrolysis of organic compounds.

### 4.3.5 Nitrate/Nitrite Nitrogen

Nitrate ($NO_3$) is the principal form of combined nitrogen in natural waters and results from the complete oxidation of other nitrogen compounds, particularly ammonia (nitrification). Nitrates stimulate the growth of plants which convert them to organic nitrogen. Nitrites ($NO_2$) are much less stable in surface waters, and are usually found in minute quantities. Nitrite is formed as an intermediate in both nitrification and denitrification. Elevated levels usually indicate active biological processes influenced by organic pollution (McNeely et al., 1979).

Nitrite is much more toxic to mammals and aquatic life than nitrates (CCREM, 1987). Provincial water quality limits for both nitrate and nitrite pertain to drinking water based on the protection of human health. The most recent Canadian Guidelines (1987) set a limit of 60 ug/L nitrite for the protection of aquatic life. No numerical limit has been established for nitrate in surface waters, although it is recognized that elevated levels may present an aesthetic problem due to nuisance plant growth.

### 4.3.6 Copper

Copper in water originates from mining activities, copper-containing pesticides, industrial copper use, metallurgy, copper pipe corrosion, fossil fuel combustion and chemicals production. Aquatic copper is generally in the form of insoluble particulates, soluble complexes and soluble divalent ions (MOE, 1979). Although it is an essential element for most aquatic organisms, elevated concentrations may result in toxicity. Toxicity is increased by decreases in water hardness and dissolved oxygen, and decreased in the presence of chelating agents, humic acids, amino acids and suspended solids (CCREM, 1987). While the most recent U.S. EPA criteria (1986) for copper is variable and dependent on water hardness, MOE (1984) and Environment Canada (1981) objectives are based on fixed limits to protect aquatic life from acute and chronic copper toxicity. The more recent Canadian Water Quality Guidelines (CCREM, 1987) recommend the EPA approach of using hardness-based criteria.

### 4.3.7 Lead

Most natural waters contain only low concentrations of lead (less than 50 ug/L), chiefly derived from the weathering of sulphide ores (McNeely et al., 1979; Environment Canada, 1981). Anthropogenic inputs to the environment, such as automobile exhaust, ore smelting and refining, and printing, dyeing, photographic and engraving processes represent much greater sources. The toxicity of lead to aquatic invertebrates and fish is greater in soft water than in hard water, so provincial and federal limits vary with ambient hardness level for the protection of aquatic life. Lead has not been shown to biomagnify through the food web (Environment Canada, 1981).

### 4.3.8 Zinc

Zinc is abundant in the environment in sulphide or carbonate forms, often in combined ores with other metal sulphides such as lead and/or copper. Zinc enters the aquatic environment as a result of weathering processes, primary zinc production, wood combustion, waste incineration and iron and steel production (Environment Canada, 1981).

Zinc is an essential element for animals and plants, used in particular enzyme functions, but is toxic at elevated levels. The acute toxicity of zinc to aquatic organisms is modified by water hardness, but chronic toxicity is not. Consequently, the most recent federal and provincial limits are not hardness-adjusted. The 30 ug/L limit coincides with measured "no-effect" levels for fish and algae (CCREM, 1987).

### 4.3.9 Oil and Grease

Guidelines for oil and grease are difficult to establish since mixtures falling into this category are complex. Since oil and grease are primarily confined to the surface layers of water, they tend to present a greater aesthetic problem than a risk to most aquatic organisms. Current Canadian and Ontario guidelines are thus based on visual and olfactory detection (MOE, 1984; CCREM, 1987). The EPA (1986) objective also provides for protection of aquatic life based on the acutely lethal concentration of individual chemicals in the mixture.

### 4.3.10 Pentachlorophenol

Forest products industries, such as wood preservation as well as pulp and paper, are probably the major sources of PCP to the environment. While no firm objectives have been established for PCP in Canadian waters, a 0.5 ug/L limit is under provincial review (McKee _et al._, 1984). While PCP has a tendency to bioaccumulate, the 0.5 ug/L limit was derived primarily from chronic toxicity data related to impairment of fish growth.

### 4.3.11 $BOD_5$

The biochemical oxygen demand of water is the amount of oxygen required to oxidize organic matter by aerobic microbial decomposition to a stable inorganic form. BOD is not a pollutant itself, but becomes a problem at high concentrations by depressing the dissolved oxygen levels to levels that affect aquatic organisms. While no specific guidelines for BOD have been established, a concentration of 4 mg/L is deemed reasonably clean and waters with levels greater than 10 mg/L are considered polluted (McNeely _et al._, 1979).

### 4.3.12 Dissolved Oxygen

The maintenance of some minimum level of dissolved oxygen in water is necessary for the respiration of most aquatic organisms. The actual concentration depends on the requirements of the specific organisms native to the water body. The PWQO and Environment Canada (1981) guidelines for dissolved oxygen are based on four possible levels of protection dependent on the estimated "value" of the fishery. For example, Level IV offers only a low level of protection to fish where fisheries are not a prime consideration. The CCREM guidelines (1987) specify particular DO concentrations as 30-day and 7-day means as well as minimum values for the protection of cold- versus warm-water fisheries at specific life stages.

### 4.3.13 Chloride

Chloride is a major inorganic ion that occurs in variable concentrations in natural waters, typically in the mg per litre range. Chloride are released to surface waters naturally during weathering of sedimentary rocks and soils or anthropogenically from hydrolysis of chlorine-disinfected wastes and runoff from salted roads. While highly elevated levels of chloride may cause a shift in the biotic community, no recommendations to protect aquatic life have been set (McNeely, 1979).

### 4.3.14 Atrazine

Atrazine is used as a herbicide on corn fields to control various grasses. There is no PWQO reference value (see Table 1).

### 4.3.15 Lindane

Lindane, also known as gamma-benzenehexachloride (gamma-BHC) or gamma-hexachlorocyclohexane, is a broad-spectrum insecticide commonly used on fruit and vegetable crops. It is very toxic to aquatic life, with acute and chronic toxicity reported for fish and invertebrates at concentrations in the low ug/L range. The rationale for the 0.01 ug/L limit is the 96-h LC50 of 1 ug/L for stoneflies, and an experimentally derived "application" (safety) factor of 0.01.

### 4.3.16 Methoxychlor

Methoxychlor is a widely-used insecticide that is relatively non-toxic to mammals but is quite toxic to aquatic life. Although it is structurally part of the DDT family, it is relatively non-persistent (McEwen and Stevenson, 1979).

The CCREM (1987) and MOE (1984) guidelines (see Table 1) are based on limited acute and chronic toxicity data. Both incorporate an arbitrary margin of safety below the lowest reported concentrations resulting in toxicity.

### 4.3.17 Total Phenolics

Aquatic limitations for total phenols refer to the range of phenolic compounds that react to the 4-aminoantipyrene test. Phenols are formed naturally during the degradation of organic matter (e.g., vegetation) or anthropogenically during processes such as coal and wood distillation, oil refining, chemical manufacturing and the degradation of human and animal wastes and pesticides.

The toxicity of phenolic compounds varies widely depending on the organism and chemical species tested and test conditions, but a limit of 200 ug/L has been recommended to protect aquatic life (CCREM 1987; MOE 1979). Organoleptic data, however, have indicated that lower concentrations of specific substituted phenolics may impart an undesirable odour to water supplies and cause tainting of fish flesh. Therefore, the 1 ug/L limit was recommended by the federal and provincial governments. The need for contaminant-specific guidelines has been acknowledged and new limits are under review for several chloro-, nitro-, andmethyl-substituted forms.

## 4.4 Comparison of Don River Water Quality to PWQO's

A summary of the concentration of various parameters and a comparison of Don River Water Quality to PWQO's and to other standards, and the frequency of exceedance has been presented in detail for the many parameters measured in the Don River Basin in the Supporting Document 5. The concentrations for recent years are qualitatively compared here to PWQO's for parameters selected for inclusion in this study. The analysis for exceedances, derived from regular monitoring program data bases, does not differentiate between wet weather and dry weather conditions. This differentiation is especially important for parameters like fecal coliforms which significantly die-off during dry weather conditions, and for metals which reach high levels during storm events, but which are mainly associated with the particulate phase.

| Parameter | Comparison to PWQO |
|---|---|
| Suspended Solids | o difficult to compare due to PWQO statement (Table 1)<br>o PWQO is probably meant for lakes rather than rivers.<br>o probably exceeds PWQO's, especially during wet weather conditions. |
| Total phosphorus | o 30 ug/L objective is routinely surpassed (80%).<br>o for 100 ug/L EPA standard, East Don exceeds 30%, West Don 50-60% and Lower Don 90% of time.<br>o The steep gradient results in little plant growth in the Don. |
| Fecal Coliforms | o Lower Don and East Don - GT 90% except for Todmorden which is 75%.<br>o West Don - 70-80% exceedances. |
| Colour | o No data available. |
| Dissolved Oxygen | o Greater than 5 mg/L most of the time at all stations. |
| BOD | o No standards; relationship to DO is crucial. |
| TKN | o No standards; relationship to DO is crucial. |
| Ammonia | o For its impact upon DO, no standard. |

| | |
|---|---|
| Un-ionized Ammonia | o 37% of time at Lakeshore Blvd., and 17% of time at Todmorden. No violations in East or West Don.<br>o Fish avoidance in tributaries, suspected to be caused by high ammonia concentrations, is not documented in monitoring data. |
| Copper | o 80% exceedance over the whole seasonal cycle in Lower Don; 30 to 60% in East Don; 60 to 70% in the West Don. |
| Lead | o 50% of samples in Lower Don, 40% of samples in West Don and 30% of samples in East Don exceed PWQO. |
| Zinc | o 30% of samples in Lower Don, 20-40% of samples in East Don, and 20-30% of samples in West Don exceed PWQO. |
| Atrazine | o No PWQO value. |
| Methoxychlor | o No violations in routine sampling.<br>o 23% exceedance in spring snowmelt. |
| Lindane | o In routine monitoring, main branch - 32% exceedance, and west branch - 4% exceedance.<br>o In snowmelt, 23% exceedance. |
| Reactive Phenolics | o Main branch - 77% violation.<br>o West branch - 32% violation |
| PCP | o 9% violations, all occurring before 1984. |

## 4.5 Water Quality Levels Required for Levels of Protection

A proposed set of water quality levels required for different degrees of protection were established as a part of Supporting Document No. 2 and after intensive consultation among MNR/MOE/MTRCA personnel. They were used as targets for assessing the cost of reaching the various levels of protection.

## 4.6 Statement of Objectives of Management Strategy

The philosophy initially advocated for the fisheries portion of the study, was adopted for the overall water quality management strategy. The main emphasis for fisheries is maintenance of the status quo and improvements where realistic opportunities for habitat enhancement and urban redevelopment present themselves. Due to the significant degradation of the fishery and the types of urban/industrial development in the Don River watershed, maintenance of the status quo and small improvements are the only realistic objectives for the Don River fishery.

The following objectives were proposed for the water quality strategy.

1. Maintain the status quo and attempt to achieve aesthetic and limited water quality improvements wherever possible.

2. Develop a warm water fishery which will provide an indication of aesthetic improvements but which will itself not be a significant recreational resource (in terms of fishing for consumption). Development of a put and take fishery with no tainted fish (e.g., no significant smell or carcinomas) whose source of contamination is attributable to the river, would be a second level of fisheries objective. A third level would be fish contaminant levels below consumption standards for all metals and SOC's.

3. Achieve some degree of body contact recreation for an appropriate time period after stormwater runoff. This recognizes that even if all CSO's and STP bacterial discharges were eliminated, normal urban stormwater contains high enough levels to contaminate the river and minimize body contact recreation. It suggests that over the long term, enough time between events and bacterial die-off may result in swimmable sections of the river. Such areas may include the G. Lord Ross Reservoir. If such levels cannot be achieved naturally, curtained off areas with disinfection may provide areas in compliance for swimming.

As well, it is desired to achieve sufficiently low bacterial levels so that incident contact with river water (wading, falling into the river) does not result in a significant risk to the person involved. This may entail both control measures and changes in the indicator organism to a more specific organism which better describes the risk.

4. Evaluate the causes of PWQO exceedance and estimate the potential increase in compliance of PWQO's for various water quality parameters for different control options.

5. Develop a set of control measures with two planning horizons in mind

   - short-term (control can be directly achieved),
   - long-term (control is achieved by substitution of chemicals in the watershed, or as redevelopment occurs such as over a 50 year planning horizon).

6. Develop the control measures into management strategies and rank them qualitatively according to their:

   - level of protection attained,
   - cost-effectiveness,
   - implementability,
   - conflict potential,
   - inter-agency logistics, and
   - public acceptability.

7. Develop a plan which is cognzsant of, and allows for, its reformulation due to such factors as:

   - further development in the headwater, and
   - urban redevelopment in older areas of the watershed.
   - different methods of solid/liquid waste handling,
   - long-term climatic change (from effect on ozone layer; $CO_2$ build-up due to fuel consumption), and
   - isostatic rebound.

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# APPENDIX 1

## TERMS OF REFERENCE
## DON RIVER WATER QUALITY MANAGEMENT PLAN

## 5.0 TERMS OF REFERENCE

### 5.1 General

The following section presents a draft Terms of Reference for the preparation of the Don River Water Quality Management Plan. The draft Terms of Reference reflect the objectives and intent of management of the Ministry, the stakeholders and the Humber River Water Quality Management Plan. The proceeding sections summarize the comments and opinions of the institutional stakeholders within the watershed and the technical studies that have been prepared by the Ministry of the Environment.

### 5.2 Terms of Reference

#### A. Preamble

The Ministry of the Environment has initiated a Toronto Area Watershed Management Strategy Study (TAWMS). The overall goal of TAWMS is to produce a comprehensive water quality management plan for the Toronto area watersheds, Don River, Mimico Creek and Humber River. In 1986, TAWMS completed a Water Quality Management Plan for the Humber River. The results of the Humber River Management Plan will be applied to Mimico Creek. The TAWMS study now requires the preparation of a water quality management plan for the Don River.

#### B. Objectives

It is recognized that the Don River is an urban stream and as a result, the water quality has been impaired by land use activities and related drainage discharge. However, the objectives of the proposed water quality management plan must reflect the goals and objectives of the municipalities, government agencies and the public located within the watershed. Generally, the management plan must develop a strategy and recommend remedial measures needed to bring about an improvement of the environmental quality and restore water usage of the Don River to levels that are consistent with these goals and objectives.

The objectives of the management plan reflect the character of water quality problems within the Don River. Therefore, the objectives can be specific to reaches of the stream and vary throughout the watercourse. The Don River can be divided into 3 distinct areas and these areas should be considered during the development of a water quality management plan for the watercourse:

Area 1: North of Steeles Avenue
Area 2: South of Steeles Avenue; North of Massey Creek
Area 3: Lake Ontario (including the Lower Don River, Keating Channel and the Inner Harbour)

Each area will require separate consideration of control options that will recognize and interrelate with both the in-reach problems and the control options and the potential pollution sources to the upstream reaches. As an example, the PWQO may be reasonable for the Don River north of Steeles Avenue while something less stringent would be more appropriate along the lower reaches.

It is foreseen that several pollution control scenarios will be developed for each specific reach of the river. Each will have several milestones having various degrees of control.

It is recommended that at least 5 levels of protection be considered that will reflect the water quality established by the Ministry of the Environment and the stakeholders. These are summarized as follows:

1. status quo
2. aesthetic improvements and limited water quality improvement
3. urban sport fisheries/non-body contact recreation
4. body contact recreation
5. meet PWQO

Within each level of protection, various control options must be outlined with an adequate implementation strategy. The total cost of each level of protection must be estimated and the total cost, per capita cost and per household cost for each control option must be outlined.

Examples of control options include but are not limited to the following:

- basic spill prevention
- elimination of cross-connections
- treatment or elimination of DWF priority outfalls
- CSO control
- animal litter control

- catchbasin cleaning
- prevention of illegal discharges
- strict policing of sewer use by-laws
- SWM ponds in major industrial and commercial areas
- enhanced spill prevention
- stricter sewer use by-laws
- SWM ponds in residential and industrial areas
- strict spill and containment control
- reduction of sediment delivery
- vigorous source control
- treatment of DWF/WWF with new technology and BMP
- riverine clean-up programs (e.g. SCOUR, SCRAPE)
- flow augmentation
- municipal industrial point source control
- snow disposal controls
- hazardous waste management (household, commercial, industrial)

The evaluation of control options referred to above is concerned mainly with existing conditions. Control options for new developments should also be identified. For example, application of the Urban Drainage Design Guidelines as well as Guidelines for Erosion and Sediment Control for Urban Construction Sites should be considered as a minimum. However, the best practical management policies for new developments should be identified in relation to the ultimate water quality objectives.

## C. Background

The Don River watershed is approximately 355 square kilometres. The river originates within the Oak Ridges moraine, just north of Highway 7, travelling 38 km before discharging to Lake Ontario through the Keating Channel at Toronto Harbour. The entire watershed is developed within the Municipality of Metropolitan Toronto accounting for approximately 57% (202 $km^2$) of the total area.

Water quality problems have been noted in the Don River since the early 1800's when dams and mills along the river affected both the fisheries and aesthetic qualities of the stream. Today, water quality concerns have escalated to include heavy metals, bacteria, pesticides, industrial organics in addition to conventional parameters. Presently, there is essentially no swimming, wading or angling along the Don River.

There has been some improvement in water quality observed along the river due to removals of waste water treatment plants and the elimination of some CSO and priority storm sewer outfalls. However, the water quality continues to range from poor in the upper reaches to obnoxious in the lower areas.

The Ministry of the Environment has documented concentration sources of pollutants and recommended mitigative measures to maintain or upgrade existing water quality conditions within the stream. In addition, the area municipalities have ongoing programs that include removal of CSO, stopping of illegal discharges to the stream and eliminating cross-connections of sanitary to storm sewers. The proposed water quality management plan is, therefore, required to coordinate the efforts of all agencies that will eventually lead to the improvement of the water quality in the Don River.

The watershed stakeholders which include government agencies, municipalities, community groups and the general public are considered to be the key to the successful implementation of a management plan. Therefore, the goals, policies and objectives of these groups are very important to the development of the program.

## D. General Terms

The water quality management plan must identify the water quality problems in the Don River, relate these problems to sources, and suggest reasonable mitigative options and associated cost estimates in a clear and concise format. The final report will be presented to the TAWMS Steering Committee, the Ministry of the Environment, the interested stakeholders and the general public. The report will be used as a basis for the final development of the management plan for the Don River by the TAWMS Steering Committee. The consultant's report will provide the Committee with an evaluation of the alternative control options, costs, suggested implementation program and recommendation for the final management plan.

It is important that the management plan be developed within the framework of the stated objectives and the concerns of the stakeholders and public. Further, the costs, and the potential for implementation of control options must be considered during development of the plan.

The study will not incorporate detailed stream modelling of the watershed or further data collection from primary sources. The study will have to address water quality benefits through control options. The majority of the information that will be used has been collected through technical studies carried out by the Ministry of the Environment. Further, it is expected that there will considerable information transfer from the experience gained from the Humber River Water Quality Management Study.

In developing the management plan, four stages are envisioned:

1. Identification of regional and site specific water quality problems within the Don River
2. Identification of objectives related to the problem areas
3. Identification and evaluation of remedial water quality control options
4. Prepare a critical path for implementation of the management plan

E. Specific Terms

1. Problem Identification

   - identify study reaches
   - address parameters of concern including bacteria, heavy metals, pesticides, industrial organics and conventional parameters
   - identify regional and site specific problem areas and possible sources of pollutants within each study reach
   - examine basin loadings with differentiation of dry and wet weather conditions

2. Objectives of Water Quality Management Plan

   - summarize the concerns of stakeholders within watershed
   - review results of public consultation process
   - compare existing water quality with Provincial Water Quality Objectives
   - summarize objective(s) and level of protection for the Don River Water Quality Management Plan
   - provide 30 copies of Interim report for distribution to Steering Committee
   - meet with TAWMS Steering Committee for approval of objective(s)

3. Control Options

- identify structural and non-structural control options
- identify feasibility of implementing control options within Don River watershed
- evaluate expected impact on water quality using appropriate technique for each option
- identify cost for each control option by total cost, cost per capita and cost per household
- conduct a cost-benefit analysis on the control options, where possible
- develop an evaluation procedure and criteria
- determine the need for specific water quality control demonstration programs that are unique to the Don River
- recommend control options that should be included in management plan

4. Implementation of Control Options

- identify potential and constraints for implementation within framework of existing programs
- identify necessary approval process
- summarize stakeholder's considerations for implementation of control options within the management plan
- develop critical path for implementation of the final management plan
- provide 30 copies of draft report for distribution to Steering Committee
- make revisions to report based on comments received by Steering Committee
- provide 30 copies of final report